TOPFIELD INTERNAL INFORMATION (2008-12-23)

HISTORY

2008-12-23 R2 provided the additional fields from the TF5700PVRt transponder block
Updated the Toppy / SysID list
2008-08-09 Added a note from R2-D2 about the REC header on the TF5810/TF500/TF600
2008-07-30 Added a note about a timer structure bug (thx to ibbi)
2008-05-08 Updated the TF5800 transponder struct and the flash header (another one from the patch and information factory R2-D2 ☺)
2008-04-29 Added the 3 DOW bits to the frontpanel's new date format (thx to R2-D2)
2008-04-13 Updated EEPROM ListInfo+0x04 and EtcInfo+0x0d/0x0e (thx to EMJB & R2-D2)
2008-02-17 Added some details to the FP Comm table
2008-01-17 Got some more EEPROM details from EMJB
Added a relative address column to the EEPROM info, which is compatible with all firmware releases
2008-01-13 Updates several FP Comm commands
Updated the SysID Table
2007-12-30 SetRemoteFilter: Added code for Mode 2
Fixed a false offset value in the service name offsets of the 5800 and 5200 (thx to EMJB)
2007-12-13: 12/24h-Flag in the EEPROM etc-Block (thx to R2-D2)
2007-09-11: Added the WinFileAttribute flags in the directory slot description (thx to Aldarin)
Corrected some details of the root directory description (thx to ibbi)
2007-07-24: Added a note about the TF5700PVRt transponder block size
2007-06-03: More details about the header of the compressed loader and firmware
2007-05-10: Added some details to the FP communication table (thx to DeadBeef)
Added the S3_CRC description in the DataFiles Directory section
2007-04-28: Added the Network ID to the Sat Timer Block (thx to R2-D2)
2007-01-27: Meaning of **unknown**[3] in the ServiceInfo block of the REC header
How to auto detect a REC header type (thx to jkIT)
2007-01-14: MHEG-Flag in the EEPROM etc-Block (thx to SimonC)

CONTENTS OF THE FLASH MEMORY

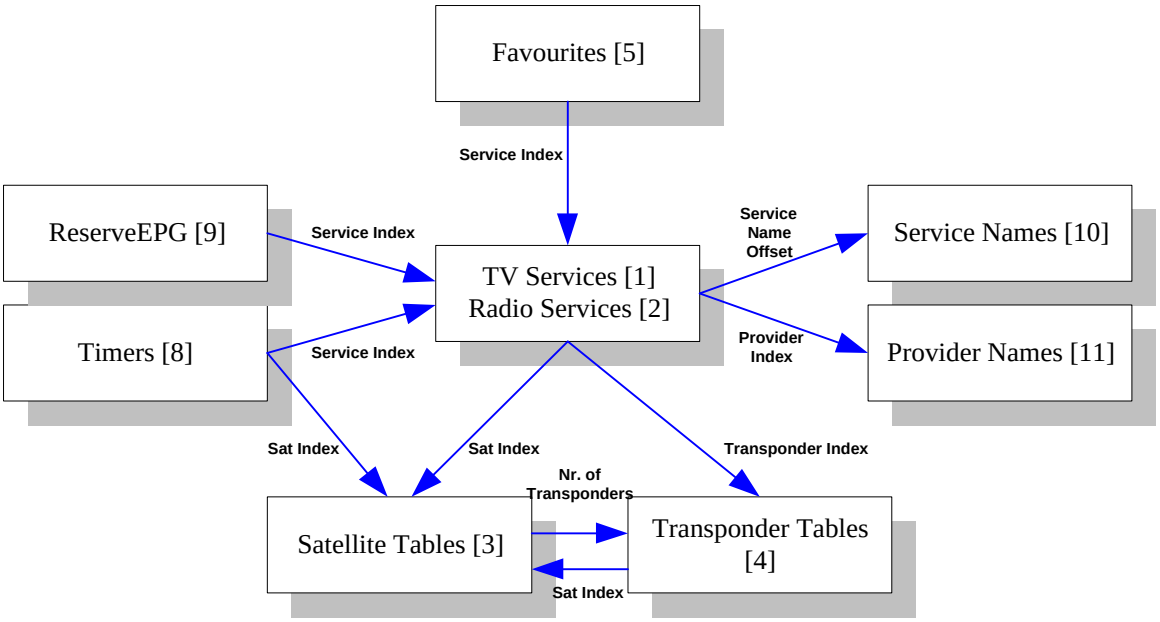
The decompressed flash memory is divided into several blocks. Every block starts with a CRC-16 (see below for the algo) followed by a 0xFFFF. The CRC calculation begins after the 0xFFFF (block start address + 4).

TF5000/5500/5000 Masterpiece
TF5800 PVRt
TF5200 PVRc

Block	Remarks	Start	End	Length	Rec Size	Records	cross links to block
1	TV Service Data	00000000 00000000 00000000	0001B583 00007D03 00007D03	112004 32004 32004	32 32 32	3500 1000 1000	3, 4, 10, 11
2	Radio Service Data	0001B584 00007D04 00007D04	00027107 0000FA07 0000FA07	48004 32004 32004	32 32 32	1500 1000 1000	3, 4, 10, 11
3	Satellite Tables	00027108 0000FA08 0000FA08	0002bcbf 0000FA2B 0000FA2B	19384 36 36	76 - -	255 - -	4
4	Transponder Data	0002BCC0 0000FA2C 0000FA2C	00037847 00010A23 00010627	48008 4088* 3068	16 16 12	3000 255 255	3
5	Favorites	00037848 00010A24 00010628	00039D17 00012EF3 00012AF7	9424 9424 9424	314 314 314	30 30 30	1, 2
6	Game Data	00039D18 00012EF4 00012AF8	00039D5F 00012F3B 00012B3F	72 72 72	- - -	- - -	
7	Clock Setup	00039D60 00012F3C 00012B40	00039D6B 00012F47 00012B4B	12 12 12	- - -	- - -	(4)
8	Timer	00039D6C 00012F48 00012B4C	0003C29F 0001547B 00014F67	9524 9524* 9244	136 136 132	70 70 70	1, 2, 3, 4
9	Reserve EPG	0003C2A0 0001547C 00014F68	0003C4D3 000156AF 0001519B	564 564 564	8 8 8	70 70 70	1, 2
10	Service Names	0003C4D4 000156B0 0001519C	0004C2BF 0002549B 00024F87	65004 65004 65004	- - -	- - -	(1), (2)
11	Provider Names	0004C2C0 0002549C 00024F88	0004D7C3 0002699F 0002648B	5380 5380 5380	21 21 21	256 256 256	(1), (2)
12	OTA	0004D7C4 - -	0004D7E7 - -	36 - -	- - -	- - -	
13	Unused	0004D7E8 000269A0 0002648C	0007FFFF 0007FFFF 0007FFFF	206872 366176 367476	- - -	- - -	
14	WLAN	0004DBEC - -	0004DFEB - -	1024 - -	- - -	- - -	
15	Unused	0004DFEC - -	0007FFFF - -	204820 - -	- - -	- - -	

Green background: all models use the same record structure.
* The transponder block on a TF5700PVRt (HDMI) is 8 bytes longer than on other machines

How the tables are cross linked:



TF5000/5500/5000 MASTERPIECE

TV SERVICE DATA [1]

A single record contains 32 bytes. The allocated space can hold up to 3500 services. Unused records are marked by a Tuner value of 00 (this is used to detect the last entry).

```
01 00 0D 74 32 C9 03 E9 00 A0 00 A0 80 A1 00 00 00 00 4E 09 00 2D 00 00 00 00 00 00 00 00 00 00
01 00 0D 50 32 D6 03 EC 00 AA 00 AA 80 AB 80 00 00 00 4D 30 00 06 00 00 00 00 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	1	Sat Index	
0x0001	1	Unused	
0x0002	2	Transponder Index & Flags	`0000 1101  01.. ....` Transponder Index with the same Sat Index (Block [4]) `.... ....  ..11 ....` Tuner (11= both Tuner, 10 =Tuner 2, 01 = Tuner 1) `.... ....  .... 0...` Delete `.... ....  .... .1..` CAS `.... ....  .... ..0.` Lock `.... ....  .... ...0` Skip
0x0004	2	ServiceID	
0x0006	2	PMT PID	
0x0008	2	PCR PID	
0x000A	2	Video PID	
0x000C	2	Audio PID	`100. .... .... ....` Auto `001. .... .... ....` Dolby Digital channel `000. .... .... ....` Fixed language
0x000E	1	Flags	`1... ....` Rename Flag `.000 00..` unused `.... ..00` Sound Mode
0x000F	1	NVOD Index	
0x0010	4	Service Name Offset	Points to the beginning of a string in block 10 (=0x0003C4D8 + Offset)
0x0014	2	Provider Index	Points to then n^{th} string in block 11
0x0016	10	Unused	

RADIO SERVICE DATA [2]

See TV Service Data [1]. The VideoPID is always 0x0000.

SATELLITE TABLES [3]

A single record contains 76 bytes.

```
00 75 FF FF H  o  t  b  i  r  d  00 00 00 00 00 00 00 00 00
82 00 A6 16 29 68 7F 00 00 01 00 00 00 00 00 00
82 00 A6 16 29 68 7F 00 00 89 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 82 00 00 00 00 00 00

00 4A FF FF A  s  t  r  a  00 00 00 00 00 00 00 00 00 00 00 00
81 00 A6 16 29 68 7F 00 00 01 00 00 00 00 00 00
81 00 A6 16 29 68 7F 00 00 81 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 C0 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	2	Number of Transponders	
0x0002	2	Reserved	
0x0004	16	Satellite Name	
0x0014	1	Tuner 1: LNB-Flags & DiSEqC 1.0	1... .... LNB Power .0.. .... SW12V (12V switched output is not implemented on (most?) Toppies. ..00 0010 DiSEqC 1.0 (0 = Disable, 1 = 1 of 4, 2 = 2 of 4, 3 = 3 of 4, 4 = 4 of 4, 5 = Mini A, 6 = Mini B)
0x0015	1	Tuner 1: DiSEqC 1.2	0... .... Motorized .000 0000 stabPosition
0x0016	2	Tuner 1: LNB Low Band Oscillator	1... .... Universal LNB .0.. .... 22kHz Switchbox ..10 0110 0001 0110 Frequency
0x0018	2	Tuner 1: LNB High Band Oscillator	0010 1001 0110 1000 Frequency
0x001A	1	Tuner 1: DiSEqC 1.2 USALS	0... .... USALS .111 1111 posIndex
0x001B	1	Tuner 1: DiSEqC 1.2 Vertical Skew	
0x001C	1	Tuner 1: DiSEqC 1.2 Hor. Skew	
0x001D	1	Tuner 1: Tuner Loop Trough	0000 00.. Magic .... ..01 Connection Type (00=sep., 01=loop)
0x001E	1	Tuner 1: DiSEqC 1.1	0 = Disable, 1 = 1 of 4, 2 = 2 of 4, 3 = 3 of 4, 4 = 4 of 4
0x001F	5	Reserved	
0x0024	1	Tuner 2: LNB-Flags & DiSEqC 1.0	0... .... USALS .111 1111 posIndex
0x0025	1	Tuner 2: DiSEqC 1.2	
0x0026	2	Tuner 2: LNB Low Band Oscillator	
0x0028	2	Tuner 2: LNB High Band Oscillator	
0x002A	1	Tuner 2: DiSEqC 1.2 USALS	
0x002B	1	Tuner 2: DiSEqC 1.2 Vertical Skew	
0x002C	1	Tuner 2: DiSEqC 1.2 Hor. Skew	
0x002D	1	Tuner 2: Tuner Loop Through	1000 00.. Magic .... ..01 Connection Type (00=sep., 01=loop)
0x002E	1	Tuner 2: DiSEqC 1.1	
0x002F	5	reserved	
0x0034	12	DefaultChannel	define.h is talking about a TYPE_DefaultChannel (maybe outdated info?)
0x0040	4	SatAngle	
0x0044	2	Satellite Position	Longitude*10
0x0046	6	reserved	

TRANSPONDER DATA [4]

A single transponder record consists of 16 bytes. The first four bytes hold the number of used transponder records.

```
00 00 01 7A
00 00 00 00 00 00 29 DF 6B 6C 2A F8 00 00 00 00
00 80 00 00 00 00 29 E3 74 CC 2B 5C 00 00 00 01
01 80 00 00 00 00 2A 50 55 F0 04 21 80 00 00 85
```

Offset	Length	Field	Remarks
	4	Number of Entries	
0x0000	1	Sat Index	
0x0001	1	Polarisation	1... .... Hor. Pol. .000 .... Mode (0=Normal, 1=SmaTV) .... 0000 unused
0x0002	2	unused	
0x0004	4	Frequency	
0x0008	2	Symbol Rate	
0x000A	2	Transport Stream ID	
0x000C	1	User selected Time Sync.	1... .... selected .000 0000 unused
0x000D	1	unused	
0x000E	2	Network ID	

FAVORITES [5]

The Favorite block can take up to 30 favorite groups. Every group contains 314 bytes. These are 12 bytes for the name, 200 bytes for 100 service indices, 100 bytes for the flag area, 1 counter byte and an unused 0x00 byte. The maximum length of the name is 11 characters.

```
N  e  w  s  00 00 00 00 00 00 00 00 00 00 00 01
00 06 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 03 00
```

Offset	Length	Field	Remarks
0x0000	12	Favorite Name	
0x000C	100 x 2	Service Indices	
0x00D4	100	Service Types	0=TV / 1 = Radio
0x0138	1	Number of Entries	
0x0139	1	Unused	

Although there is a ServiceType flag for every service entry, it is not allowed to mix radio and TV services within one group.

GAME DATA [6]

```
00 07 A1 20 00 0F 42 40 00 0F 42 40 00 0F 42 40
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 02 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF
```

Offset	Length	Field	Remarks
0x0000	4 x 4	Money	
0x0010	4 x 4	Win	
0x0020	4 x 4	Lose	
0x0030	4	exblockClearStage	
0x0034	16	reserved	

CLOCK SETUP [7]

The following structure shows all flags of all models seen so far. As these are implemented by software, future firmware version might add more flags. The 5000 Masterpiece does not use the Automatic Time Offset-flag.

```
00 78 00 00 08 FF FF FF
```

Offset	Length	Field	Remarks
0x0000	2	UTC Offset	Offset in minutes
0x0002	2	Sleep Timer	
0x0004	1	Flags1	`000. ....` unused `...0 00..` GMT collection (see Transponder Block Offset 0x10) (00=Normal, 01=CAS Only, 10=User Select) `.... ..00` Mode (0=Auto, 1=Manual)
0x0005	1	Flags2	`1111 111.` unused `.... ...1` Time Offset (0=Manual, 1=Automatic)
0x0006	1	Flags3	`11.. ....` DST (00=off, 11=on) `..11 1111` unused
0x0007	1	Flags4	`1111 1111` unused

TIMER BLOCK [8]

A single timer record consists of 136 bytes. The maximum length of the file name is 98 characters. This includes the terminating 0x00. On non-PVRs (e.g. the 5000CI), bytes 0x14 to 0x87 are unused.

```
00000000h: 01 40 01 01 00 0A 00 00 D0 38 13 2D D0 38 13 37 01 01 32 C9
00000014h: Wetter-1.rec…
00000074h: 00 00 01 DE 01 80 00 00 00 00 31 94 55 F0 04 5D 80 00 00 01
```

Offset	Length	Field	Remarks
0x0000	1	TunerIndex	
0x0001	1	Flags	010. .... Rec. Mode (0=none, 1=recording, 2=reserved recording, 3=temp. recording, 4=copy) ...0 0... Demux Path .... .00. Res. Type (1=manual recording (no SID, EventID)) ....0 unused
0x0002	1	SatIndex	
0x0003	1	Type & Reservation	0... .... Service Type (0= TV, 1=Radio) .000 0001 0 = One Time, 1 = Every Day, 2 = Every Weekend, 3 = Weekly, 4 = Every Weekday
0x0004	2	Duration	In minutes
0x0006	2	Service Index	
0x0008	4	Start Time	DDHM (DD=days since 17.11.1858)
0x000C	4	End Time *1	DDHM
0x0010	1	isRec	P = 0, R = 1
0x0011	1	setName	
0x0012	2	ServiceID	
0x0014	96	File Name	
0x0074	2	EPGMarker	2 = Rt
0x0076	2	EventID	
			The following part has the same structure as block 4
0x0078	1	SatIndex	
0x0079	1	Polarization	B7=Hor. Pol.
0x007A	4	Unused	
0x007E	2	Frequency	
0x0080	2	SymbolRate	
0x0082	2	TransportStreamID	
0x0084	1	Scrambled Service	1... .... Scrambled .000 0000 unused
0x0085	1	Unused	
0x0086	2	NetworkID	

*1 Due to a bug, this field may contain the duration. It is safer to calculate the end time by adding the start time and the duration

RESERVEEPG BLOCK [9]

This block contains 70 EventID-StartTime pairs. The most recent entry found in this block was from December 2004 and on the 5800 & 5200 models, this block isn't used (0xFF). So it seems that this block is not used in current firmware versions any more.

```
00 00 04 39 D0 6E 00 33
```

Offset	Length	Field	Remarks
0x0000	2	Flags	00.. .... reserved ..0. .... Service Type (0=Radio, 1=TV) ...0 0000 0000 0000 Service Index
0x0002	2	EventID	
0x0004	4	Start Time	

SERVICE NAMES [10]

This block simply contains a list of NULL-terminated strings.

PROVIDER NAMES [11]

This table contains the name strings of the service providers. Every record is 21 bytes long. The end of the table is indicated by a zero length string.

OTA [12]

This block does not contain any useful data.

TF5800 PVRT
TV SERVICE DATA [1]

A single record contains 32 bytes. The allocated space can hold up to 1000 services. Unused records are marked by a Tuner value of 00 (this is used to detect the last entry).

```
00 00 0E B0 57 00 02 C0 01 91 01 91 81 92 20 00 00 00 01 35 00 03 00 0C 00
00 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	2	Unused	
0x0002	2	Transponder Index & Flags	`0000 1110 10.. ....` Transponder Index (Block [4]) `.... .... ..11 ....` Tuner (11= both Tuner, 10 = Tuner 2, 01 = Tuner 1) `.... .... .... 0...` Delete `.... .... .... .0..` CAS `.... .... .... ..0.` Lock `.... .... .... ...0` Skip
0x0004	2	ServiceID	
0x0006	2	PMT PID	
0x0008	2	PCR PID	
0x000A	2	Video PID	
0x000C	2	Audio PID	B15 = always set
0x000E	1	Flags	`0... ....` Rename Flag `.010 00..` **unknown** `.... ..00` Sound Mode
0x000F	1	NVOD Index	
0x0010	4	Service Name Offset	Points to the beginning of a string in block 10 (=0x000156B0 + Offset)
0x0014	2	Provider Index	Points to then nth string in block 11
0x0016	2	Logical Channel Number	
0x0018	8	Unused	

RADIO SERVICE DATA [2]

See TV Service Data [1]. The VideoPID is always 0xFFFF.

SATELLITE TABLES [3]

```
00 72 44 56 42 54 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	2	Number of Transponders	
0x0002	4	String “DVBT”	
0x0004	26	unused	

TRANSPONDER DATA [4]

A single transponder record consists of 16 bytes. The first four bytes hold the number of used transponder records. On Australian machines, the channel number is coded in BCD instead of binary. In addition the channel 9A is shown as 0x009A.

```
00 00 00 72

00 2A 08 00 00 09 CB D0 50 00 00 00 23 3A 00 00
```

Offset	Length	Field	Remarks
	dword	Number of Entries	
0x0000	byte	SatIdx	Always 0
0x0001	byte	Channel Number	
0x0002	byte	Bandwidth	[MHz]
0x0003	byte	unused	
0x0004	dword	Frequency	[kHz]
0x0008	word	Transport Stream ID	
0x000A	byte	LP/HP Stream	0 = LP Stream, 1= HP Stream
0x000B	byte	unused	
0x000C	word	OriginalNetwork ID	
0x000E	word	NetworkID	
		TF5700PVRt only	
0x0010	byte	Code Rate – HP Stream	1/2, 2/3, 3/4, 5/6, 7/8
0x0011	byte	Guard Interval	1/32, 1/16, 1/8, 1/4
0x0012	byte	Transmission Mode	2k, 8k, 4k
0x0013	byte	unused	
0x0014	byte	Constellation	QPSK, 16-QAM, 64-QAM
0x0015	byte	unused	
0x0016	byte	unused	
0x0017	byte	unused	

Note: The transponder block on a TF5700PVRt (HDMI) is 8 bytes longer than on other machines.

Favorites [5]

The Favorite block can take up to 30 favorite groups. Every group contains 314 bytes. These are 12 bytes for the name, 200 bytes for 100 Service indices, 100 bytes for the flag area, 1 counter byte and an unused 0x00 byte. The maximum length of the name is 11 characters.

```
N  e  w  s  00 00 00 00 00 00 00 00 00 00 00 01
00 06 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 03 00
```

Offset	Length	Field	Remarks
0x0000	12	Favorite Name	
0x000C	100 x 2	Service Indices	
0x00D4	100	Service Types	0=TV / 1 = Radio
0x0138	1	Number of Entries	
0x0139	1	Unused	

Although there is a ServiceType flag for every service entry, it is not allowed to mix radio and TV services within one group.

Game Data [6]

```
00 07 A1 20 00 0F 42 40 00 0F 42 40 00 0F 42 40
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 02 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF
```

Offset	Length	Field	Remarks
0x0000	4 x 4	Money	
0x0010	4 x 4	Win	
0x0020	4 x 4	Lose	
0x0030	4	exblockClearStage	
0x0034	16	reserved	

CLOCK SETUP [7]

The following structure shows all flags of all models seen so far. As these are implemented by software, future firmware version might add more flags. The 5800 does not use the GMT Collection-flags and the DST-flags.

```
00 3C 00 00 E0 01 FF FF
```

Offset	Length	Field	Remarks
0x0000	2	UTC Offset	Offset in minutes
0x0002	2	Sleep Timer	
0x0004	1	Flags1	`111. ....` unused `...0 00..` GMT collection (see Transponder Block Offset 0x10) (00=Normal, 01=CAS Only, 10=User Select) `.... ..00` Mode (0=Auto, 1=Manual)
0x0005	1	Flags2	`0000 000.` unused `.... ...1` Time Offset (0=Manual, 1=Automatic)
0x0006	1	Flags3	`11.. ....` DST (00=off, 11=on) `..11 1111` unused
0x0007	1	Flags4	`1111 1111` unused

TIMER BLOCK [8]

A single timer record consists of 136 bytes. The maximum length of the file name is 98 characters. This includes the terminating 0x00.

```
00000000h: 03 42 00 00 00 40 00 01 D1 9A 14 04 D1 9A 15 08 01 01 10 85
00000014h: Secret of Drawing_10-15.rec
00000074h: 00 00 00 00 00 35 08 00 00 0B 23 90 10 05 00 00 23 3A 00 00
```

Offset	Length	Field	Remarks
0x0000	1	TunerIndex	
0x0001	1	Flags	010. .... Rec. Mode (0=none, 1=recording, 2=reserved recording, 3=temp. recording, 4=copy) ...0 0... Demux Path .... .00. Res. Type (1=manual recording (no SID, EventID)) ....0 unused
0x0002	1	unused	
0x0003	1	Mode & Reservation Type	0... .... Service Type (0= TV, 1=Radio) .000 0001 0 = One Time, 1 = Every Day, 2 = Every Weekend, 3 = Weekly, 4 = Every Weekday
0x0004	2	Duration	In minutes
0x0006	2	Service Index	
0x0008	4	Start Time	DDHM (DD=days since 17.11.1858)
0x000C	4	End Time [*1]	DDHM
0x0010	1	isRec	P = 0, R = 1
0x0011	1	setName	
0x0012	2	ServiceID	
0x0014	96	File Name	
0x0074	2	EPGMarker	2 = Rt
0x0076	2	EventID	
			The following part has the same structure as block 4
0x0078	byte	SatIdx	Always 0
0x0079	byte	Channel Number	
0x007A	byte	Bandwidth	[MHz]
0x007B	byte	unused	
0x007C	dword	Frequency	[kHz]
0x0080	word	Transport Stream ID	
0x0082	byte	LP/HP Stream	0 = LP Stream, 1= HP Stream
0x0083	byte	unused	
0x0084	word	OriginalNetwork ID	
0x0086	word	NetworkID	
		TF5700PVRt only	
0x0088	byte	Code Rate – HP Stream	1/2, 2/3, 3/4, 5/6, 7/8
0x0089	byte	Guard Interval	1/32, 1/16, 1/8, 1/4
0x008A	byte	Transmission Mode	2k, 8k, 4k
0x008B	byte	unused	
0x008C	byte	Constellation	QPSK, 16-QAM, 64-QAM
0x008D	byte	unused	
0x008E	byte	unused	
0x008F	byte	unused	

[*1] Due to a bug, this field may contain the duration. It is saver to calculate the end time by adding the start time and the duration

Note: The transponder block on a TF5700PVRt (HDMI) is 8 bytes longer than on other machines.

RESERVEEPG BLOCK [9]

This doesn’t contain any data on the 5800.

SERVICE NAMES [10]

This block simply contains a list of 0x00-terminated strings.

PROVIDER NAMES [11]

This table contains the name strings of the service providers. Every record is 21 bytes long. The end of the table is indicated by a zero length string.

TF5200 PVRc

TV Service Data [1]

A single record contains 32 bytes. The allocated space can hold up to 1000 services. Unused records are marked by a Tuner value of 00 (this is used to detect the last entry).

```
00 00 02 F0 00 12 00 67 0A FF 0A FF 8B 00 20 00 00 00 04 FE 00 06 04 56 00
00 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	2	Unused	
0x0002	2	Transponder Index & Flags	0000 0010 11.. .... Transponder Index (Block [4]) ....11 .... Tuner (11= both Tuner, 10 = Tuner 2, 01 = Tuner 1) .... 0... Delete .... .0.. CAS ....0. Lock ....0 Skip
0x0004	2	ServiceID	
0x0006	2	PMT PID	
0x0008	2	PCR PID	
0x000A	2	Video PID	
0x000C	2	Audio PID	B15 = always set
0x000E	1	Flags	0... .... Rename Flag .010 00.. **unknown** .... ..00 Sound Mode
0x000F	1	NVOD Index	
0x0010	4	Service Name Offset	Points to the beginning of a string in block 10 (=0x0001519C + Offset)
0x0014	2	Provider Index	Points to then nth string in block 11
0x0016	2	Logical Channel Number	
0x0018	8	Unused	

Radio Service Data [2]

See TV Service Data [1]. The VideoPID is always 0xFFFF.

Satellite Tables [3]

```
00 72 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Offset	Length	Field	Remarks
0x0000	2	Number of Transponders	
0x0002	30	Unused	

TRANSPONDER DATA [4]

A single transponder record consists of 12 bytes. The first four bytes hold the number of used transponder records.

```
00 00 00 25
00 05 C4 90 1A F4 00 04 00 85 02 00
```

Offset	Length	Field	Remarks
	4	Number of Entries	
0x0000	4	Frequency	[kHz]
0x0004	2	Symbol Rate	
0x0006	2	Transport Stream ID	
0x0008	2	Network ID	
0x000A	1	Modulation	0=16QAM, 1=32QAM, 2=64QAM, 3=128QAM, 4=256QAM
0x000B	1	unused	

FAVORITES [5]

The Favorite block can take up to 30 favorite groups. Every group contains 314 bytes. These are 12 bytes for the name, 200 bytes for 100 Service indices, 100 bytes for the flag area, 1 counter byte and an unused 0x00 byte. The maximum length of the name is 11 characters.

```
N  e  w  s  00 00 00 00 00 00 00 00 00 00 00 01
00 06 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 03 00
```

Offset	Length	Field	Remarks
0x0000	12	Favorite Name	
0x000C	100 x 2	Service Indices	
0x00D4	100	Service Types	0=TV / 1 = Radio
0x0138	1	Number of Entries	
0x0139	1	Unused	

Although there is a ServiceType flag for every service entry, it is not allowed to mix radio and TV services within one group.

GAME DATA [6]

```
00 07 A1 20 00 0F 42 40 00 0F 42 40 00 0F 42 40
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 02 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF
```

Offset	Length	Field	Remarks
0x0000	4 x 4	Money	
0x0010	4 x 4	Win	
0x0020	4 x 4	Lose	
0x0030	4	exblockClearStage	
0x0034	16	reserved	

CLOCK SETUP [7]

The following structure shows all flags of all models seen so far. As these are implemented by software, future firmware version might add more flags. The 5200 does not use the GMT Collection-, Time Offset- and the DST-flags.

```
00 78 00 00 E0 00 FF FF
```

Offset	Length	Field	Remarks
0x0000	2	UTC Offset	Offset in minutes
0x0002	2	Sleep Timer	
0x0004	1	Flags1	`111. ....` unused `...0 00..` GMT collection (see Transponder Block Offset 0x10) (00=Normal, 01=CAS Only, 10=User Select) `.... ..00` Mode (0=Auto, 1=Manual)
0x0005	1	Flags2	`0000 000.` unused `.... ...0` Time Offset (0=Manual, 1=Automatic)
0x0006	1	Flags3	`11.. ....` DST (00=off, 11=on) `..11 1111` unused
0x0007	1	Flags4	`1111 1111` unused

TIMER BLOCK [8]

A single timer record consists of 132 bytes. The maximum length of the file name is 98 characters. This includes the terminating 0x00.

```
00000000h: 03 42 00 00 00 18 00 0D D1 9D 12 3B D1 9D 13 17 01 01 6D 67
00000014h: heute-Nachrichtenmagazin des ZDF-18-10.rec
00000074h: 00 00 00 00 00 06 03 10 1A F4 04 37 00 01 02 00
```

Offset	Length	Field	Remarks
0x0000	1	TunerIndex	
0x0001	1	Flags	010. .... Rec. Mode (0=none, 1=recording, 2=reserved recording, 3=temp. recording, 4=copy) ...0 0... Demux Path .... .00. Res. Type (1=manual recording (no SID, EventID)) ....0 unused
0x0002	1	unused	
0x0003	1	Mode & Reservation Type	0... .... Service Type (0= TV, 1=Radio) .000 0001 0 = One Time, 1 = Every Day, 2 = Every Weekend, 3 = Weekly, 4 = Every Weekday
0x0004	2	Duration	In minutes
0x0006	2	Service Index	
0x0008	4	Start Time	DDHM (DD=days since 17.11.1858)
0x000C	4	End Time [*1]	DDHM
0x0010	1	isRec	P = 0, R = 1
0x0011	1	setName	
0x0012	2	ServiceID	
0x0014	96	File Name	
0x0074	2	EPGMarker	2 = Rt
0x0076	2	EventID	
			The following part has the same structure as block 4
0x0078	4	Frequency	[kHz]
0x007C	2	Symbol Rate	
0x007E	2	Transport Stream ID	
0x0080	2	Network ID	
0x0082	1	Modulation	0=16QAM, 1=32QAM, 2=64QAM, 3=128QAM, 4=256QAM
0x0083	1	unused	

[*1] Due to a bug, this field may contain the duration. It is saver to calculate the end time by adding the start time and the duration

RESERVEEPG BLOCK [9]

This doesn't contain any data on the 5800.

SERVICE NAMES [10]

This block simply contains a list of 0x00-terminated strings.

PROVIDER NAMES [11]

This table contains the name strings of the service providers. Every record is 21 bytes long. The end of the table is indicated by a zero length string.

CONTENTS OF THE EEPROM

The size of the EEPROM is 256 bytes (24WC02). It is divided into several blocks, which start with a CRC16 (see below for the algo). Some models do not use all blocks.

```
00000000h: 06 0A 00 1A 00 3E 00 02 FF FF FF FF 11 02 0F 20
00000010h: 05 04 FF 0C 0C 0C 01 00 FF FF 24 00 00 00 00 00
00000020h: 00 00 00 00 00 00 00 00 31 C0 00 00 FF 02 1B 00
00000030h: FF FF 00 00 00 00 3A C0 00 A4 01 E2 F4 76 00 FF
00000040h: 00 03 00 00 00 00 00 00 9E 5B FC 05 FF FF FF FF
00000050h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
00000060h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
00000070h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
00000080h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
00000090h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000A0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000B0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000C0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000D0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000E0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
000000F0h: FF FF FF FF FF FF FF FF FF FF FF FF 44 FF FF 00
```

Absolute	Relative	Length	Field	Remarks
				Etc Info
0x00	----	2	CRC16	
0x02	0x00	2	TV Channel Sub	
0x04	0x02	2	TV Channel Main	
0x06	0x04	2	Radio Channel	
0x08	0x06	2	Old TV Channel	
0x0A	0x08	2	Old Radio Channel	
0x0C	0x0A	1	Volume	
0x0D	0x0B	1	Flags	0... .... Service Type (0 = TV, 1 = Radio) .00. .... Sound Mode (0=Stereo, 1=Mono, 2=Left, 3=Right) ...0 0... Scart Output Source .... .01. Video Output (0=CVBS, 1=RGB, 2=S-Video, 3=YUV) ....0 TV Aspect Ratio (0=4:3, 1=16:9)
0x0E	0x0C	1	Configuration Flags	.0.. .... N(C)PC (has to do with the 5500 VFD) ..00 .... ???
0x0F	0x0D	1	Flags	001. .... RF Output (0=NTSC-M, 1=PAL-G, 2=PAL-I, 3=PAL-K) ...0 .... Disable Subtitle .... 0... Disable Teletext .... .00. 16:9 Display Format (0=letterbox, 1=center extract) ....0 Dolby
0x10	0x0E	1	InfoBox Hide Time	In seconds
0x11	0x0F	1	Active Fav. Number	
0x12	0x10	1	Current Fav. Group Nr.	(0xFF means that no group is active)
0x13	0x11	1		0000 11.. Infobox Position .... ..00 TV Type (0=Multi, 1=PAL, 2=NTSC)
0x14	0x12	1	Transparency	
0x15	0x13	1		0... .... MovingConfirmBox .0.. .... satDelete ..0. .... Scart Type (0=Standard, 1=External A/V) ...0 1... PIP Position .... .1.. Svc Help Window .... ..0. Time Shift ....0 unused
0x16	0x14	1	Current Tuner Sub	0=Tuner 1, 1=Tuner 2
0x17	0x15	1	Current Tuner Main	0=Tuner 1, 1=Tuner 2
0x18	0x16	2	MultiFeed Service Nr.	
0x1A	0x18	1	rfChannel	UHF channel number
0x1B	0x19	1	Unused	
0x1C	0x1A	1	Unused	
0x1D	0x1B	1	Factory Country Code	1 for "Italy", 2 for "Other Europe"
0x1E	0x1C	1	Flags	0... .... 12/24h formt (1=12h Mode) ..0. .... MHEG Disable (1=disabled)
0x1F	0x1D	1	OldTVFavGroup	

Absolute	Relative	Length	Field	Remarks
0x20	0x1E	1	OldRadioFavGroup	
0x21	0x1F	1	unused	

Parental Info

0x22	----	2	CRC16	
0x24	0x00	2	PIN Code	
0x26	0x02	1	Rate	0=No block, 1=4 years, 2=5 years,…, 15=18 years, 16=Total block
0x27	0x03	1	Lock Flags	B7 = Time Setting locked/unlocked B6 = Language Setting B5 = A/V Output Setting B4 = Organizing Services B3 = Organizing Favorites B2 = Common Interface B1 = Installation B0 = Boot Lock

Language Info

0x28	----	2	CRC16	
0x2A	0x00	1	Menu	0 = English, 1 = French, 2 = Deutsch, 3 = Italian, 4 = Spanish, 5 = Arabic, 6 = Greek, 7 = Türkce, 8 = Danish, 9 = Swedish, 10 = Norwegian, 11 = Dutch, 12 = Russian, 13 = Polish, 14 = Persian, 15 = Suomi, 16 = Slovak, 17 = Thai, 18 = Czech
0x2B	0x01	1	Teletext	See above
0x2C	0x02	1	1st Subtitle	See above
0x2D	0x03	1	1st Audio	See above

Recent Info

0x2E	----	2	CRC16	
0x30	0x00	1	2nd Subtitle	See Language info
0x31	0x01	1	2nd Audio	See Language info
0x32	0x02			
0x35	0x35			

MyPos Info (USALS)

0x36	----	2	CRC16	
0x38	0x00	2	Longitude	*10
0x3A	0x02	2	Latitude	*10

List Info

0x3C	----	2	CRC16	
0x3E	0x00	1	Show Provider	(0=off, 1=on)
0x3F	0x01	1	Sat Index	
0x40	0x02	1	Sort Mode	(0=none, 1=name, 2=Satellite, 3=FTA/CAS, 4=CAS/FTA, 5=Provider, 6=FAV/No FAV)
0x41	0x03	1	Tuner	(1=Tuner 1, 2=Tuner 2, 3=All Tuner)
0x42	0x04	1	Sort Order	(0=Sort on time/date, 1=Sort alphabetically, 2=Sort on file size)
0x43	0x05	5	Unused	

?

0x48	----	2	CRC16	
0x4A	0x00			
0x51	0x49			

?

0x52	----	170		Unused[1]
0xFC	----	1	Power Status	0x44 = Standby, 0x88 = On
0xFD	----	1		Unused[1]
0xFE	----	1		Unused[1]
0xFF	----	1		0x00

[1] the default pattern differs on different machines. Maybe these locations aren't touched by factory reset and contain the original manufacturer's pattern.

STRUCTURE OF THE .STD FILE

This file holds the user settings located in the flash memory and the contents of the EEPROM memory. While the EEPROM data is uncompressed, the data inside of the flash memory is compressed using Haruhiko Okomuras AR002 algorithm (used by the old DOS LHArc V2.x). These up to 64 x 8kB blocks have nothing in common with the internal data structures.

00000-0003F: The .std file header.
00040-0007F: The flash header. This is the real start of the flash memory area 2 (user settings).
00080-0107F: The directory for the compressed data blocks is located here.
01080-0143F: 0x00
01440-2003F: Compressed flash data blocks.
20040-2013F: Uncompressed contents of the EEPROM

.STD-FILE HEADER

```
00000000: ToPfIeLd
00000008: 00 02 (File Version)
0000000A: 01 96 (System ID = 406)
0000000C: 1F 1D 1D FF 01 01 96 06 00 00 00 8F 22 1E D0 90 (ModelID)
0000001C: 0F 04 00 88 10 13 FF 0B B8 0D AC 05 DC 00 17 02 (ModelID contd.)
0000002C: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF (Padding)
```

On machines with the ST5518 processor (e.g. TF6060CI), the ModelID is 36 bytes long due to the way how the compiler manages the bitfields on this little endian processor. In this case only 16 padding bytes are used so that the header is aways 64 bytes long.

FLASH HEADER

```
00000040: 1F 1D 1D FF 01 01 96 06 00 00 00 8F 22 1E D0 90 (ModelID)
00000050: 0F 04 00 88 10 13 FF 0B B8 0D AC 05 DC 00 17 02 (ModelID contd.)
00000060: 00 40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 (Nr. of 8k Blocks)
00000070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

DIRECTORY

Every entry is 64 bytes long.

	CRC -File Offset-Packed Size-Unpkd. Size	
00000080h	AE 70-18 9A-00 00 14 00-00 00 04 D1-00 00 20 00	CRC Packed Data=AE70; CRC Unpacked Data=189A, Offset=00001400 (00001440 in the .std-File because of the .std file header), Packed Size=04D1, Unpacked Size=2000
000000c0h	A0 85-91 BC-00 00 1C 00-00 00 00 42-00 00 20 00	The next directory entry
00000100h	A0 85-91 BC-00 00 20 00-00 00 00 42-00 00 20 00	
00000140h	A0 85-91 BC-00 00 24 00-00 00 00 42-00 00 20 00	
00000180h	A0 85-91 BC-00 00 28 00-00 00 00 42-00 00 20 00	
000001c0h	F7 CC-8A E0-00 00 2C 00-00 00 00 46-00 00 20 00	
00000200h	BD 27-59 1E-00 00 70 00-00 00 00 3E-00 00 20 00	
00000240h	BD 27-59 1E-00 00 78 00-00 00 00 3E-00 00 20 00	

Every data block is a full TFD file (SystemID=0xFFFF, Nr of blocks=1). See below for format details. Every data block has to start at a 1k boundary. There is a minor difference in the default-block of a TFD-file: it just contains only two valid entries. The first one is for the default settings and the second for the default EEPROM. Therefore the default settings block contains more than one TFD block.

STRUCTURE OF THE .TFD FILE

The .tfd-format is used for PC => Topfield transfers. If Vega is used to upload settings, a temporary .tfd file is created and its contents is transferred to the Toppy. The .tfd-file may contain more than one data type (see Available blocks). The maximum size of the uncompressed blocks is 32762 ($7FFA) bytes. The data is compressed using the same AR002 algorithm as the .std file.

Sample .tfd file:

File Header

```
00000000h: 00 08 0E 98 01 96 00 01 00 06          -
```

HeaderLength-2 | Header CRC (SystemID+FileVersion+NrOfBlock) | SystemID | FileVersion | NrOfBlocks

Data blocks:

```
0000000ah: 10 DB 3A F9 00 02 7F FA 0F D7 87 5D …-
000010e7h: 0A 8D DD 97 00 02 7F FA 0A 04 7E DB …-
00001b76h: 05 7E 1A 9A 00 02 7F FA 05 15 75 EE …
000020f6h: 00 8F 6F 5E 00 02 7F FA 00 B7 54 54 …
00002187h: 00 0F BF 86 00 02 00 18 00 02 20 04 …
00002198h: 00 4C 5C 8D 00 03 01 00 00 33 4A 6D …
000021e6h: <EOF>
```

DataBlockSize (incl. Header-2) | CRC (BlockType+UncompressedSize+Data) | BlockType | UncompressedSize

The above sample consists of 5 type-2 blocks (Flash settings) and a single type-3 block (EEPROM).

Inside of the flash memory, the block header is a little bit different and endian format is inconsistent. On a 5000MP, the secondary loader uses little endian and the firmware uses big endian words.

Sample secondary loader:

```
bfc02000h: 00 80 5E 2E 20 A2 85 EF 5F 7D …-
bfc04e62h: 00 80 8D 1E 15 DF 83 F0 FB D6 …
…
bfc0c2f9h: FE FE DE 77 FF FF             …-
```

UncompressedSize | CompressedSize

End of data

Sample firmware:

```
bfc20000h: 7F FA 2E 42 41 D0 20 8A 84 DD …-
bfc22e62h: 7F FA 27 A0 30 4F 1B 14 84 F7 …
…
bfd88ce3h: FE FE DE 77 FF FF             …-
```

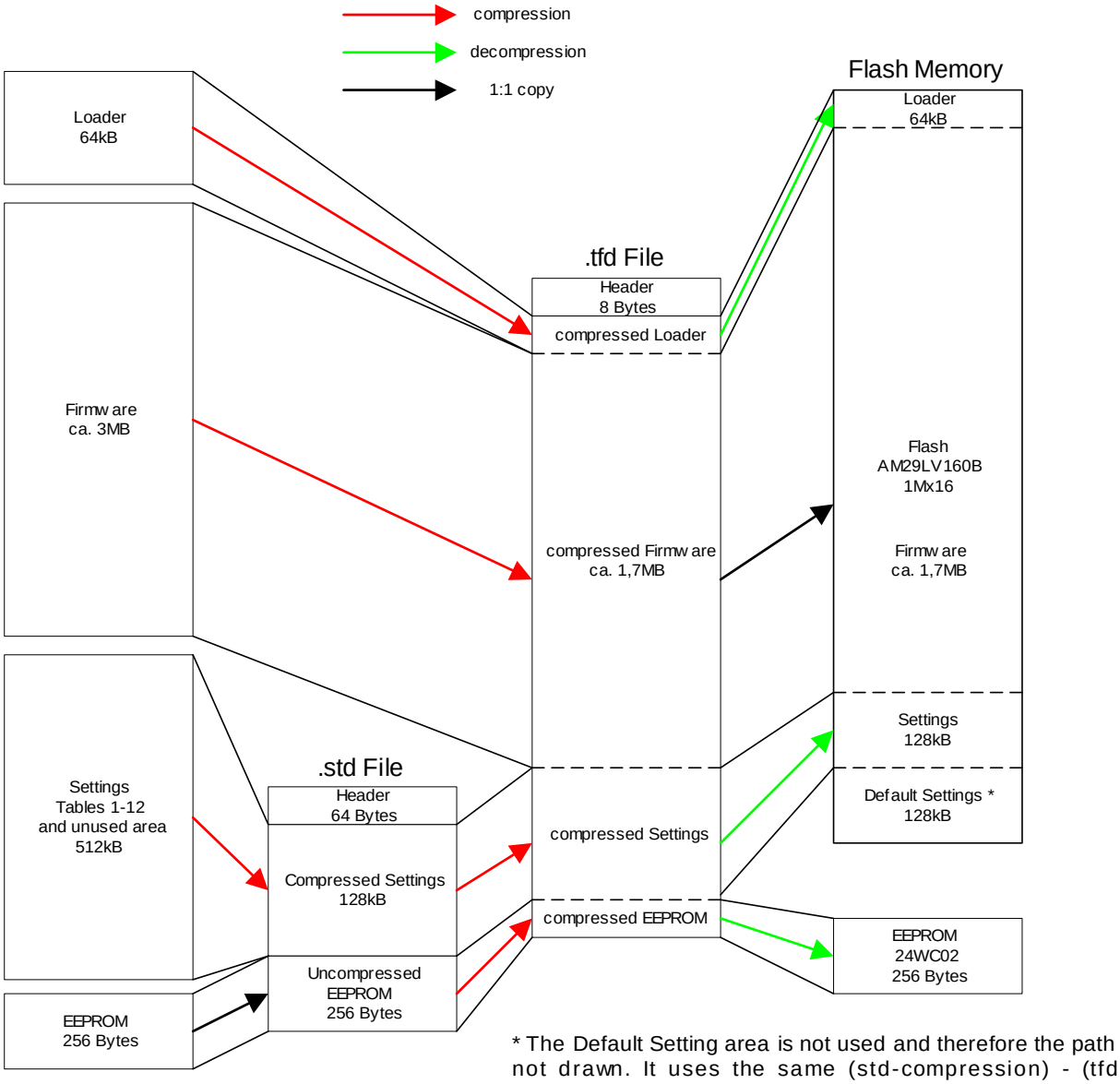
UncompressedSize | CompressedSize (incl. CRC-16) | CRC-16

End of data

COMMUNICATING WITH THE LOADER

Note: While Topfield uses the terms „Download“ and „Upload“ from the STBs standpoint (download means a transfer from the PC to the STB), this document uses “PC => STB” and “STB => PC” to minimize confusion.

When transferring data from the Topfield, all blocks are transferred as they are saved in the flash/EEPROM memory. This means that the EEPROM and loader are uncompressed and the user and default settings use the std-format. The only exception is the firmware, which is stored in the tfd-format but is decompressed on the STB => PC transfer. On PC => STB transfers, all blocks have to be packed into a single tfd file. The loader, firmware and EEPROM are uncompressed and the settings and default settings use the std-format.



* The Default Setting area is not used and therefore the path not drawn. It uses the same (std-compression) - (tfd compression) - (tfd-decompression) as the standard settings.

Serial communication parameters: 115200 / N / 8 / 1

DATA PACKETS

The transfer follows the same scheme for both directions. Every command (with the exception of CMD06 and CMD0B) has to be acknowledged.

Serial: ToFi <Seq:1> <Cmd:1> <Len:1> <Data:n> <CRC:1>
USB: ToFi <Seq:1> <Cmd:1> <Len:2> <Data:n> <CRC:1>

Seq is the sequence number. Every answer to a command needs to have the same sequence number as the command itself. Commands which belong together are marked with the same color in the following table.
CRC The CRC uses a very simple formula: (Summ of all bytes after the ToFi-string) AND 0xFF.

Cmd	Name	Data Len	Direction	Data	Notes
01	CMD_ChkReq	34	P ← T	<SystemID:2> + <ModelID:32>	Identification of the receiver
02	CMD_ChkReply	00	P → T	-	CMD01-answer to initiate a PC => STB transfer
03	CMD_UploadReq	00	P → T	-	CMD01-answer to initiate a STB => PC transfer
04	CMD_DataReq	04 or 05	P ⇆ T	NumberOfBytes:1 or 2 StartAddress:3	Request data. This command may reset the sequence number. Maximum blocksize: serial=255, USB=32762
05	CMD_DataReply	n	P ⇆ T	Data:n	Answer to CMD04
06	CMD_Terminate	00	P ⇆ T	-	End of the communication (End). There's no answer to this CMD.
07	CMD_DataSizeReq	01	P ⇆ T	Block:1	Prepare transfer (see below for available blocks)
08	CMD_DataSizeReply	03	P ⇆ T	BlockLength:3	Answer to CMD07 (total length of the requested block)
09		00	P → T	-	Request STB-identification
0A		34	P ← T	<SystemID:2> + <ModelID:32>	Answer to CMD09 (same content as CMD01 after a Toppy reset)
0B	CMD_Reboot	00	P → T	-	STB Reboot; the sequence number restarts at 0x00; no answer
FF		n	P ← T	Message:n	Loader information in clear text. Sent by the STB after a reset and doesn't expect an answer.

AVAILABLE BLOCKS

Block	Name	Display	
00	DATA_TYPE_LoaderPgm	L	Loader
01	DATA_TYPE_ApplPgm	A	Firmware
02	DATA_TYPE_FlashData	C	User Settings
03	DATA_TYPE_EepromData	E	EEPROM
04	DATA_TYPE_PrePgm	P	Factory Settings
05	DATA_TYPE_Background	?	Radio Background Picture[*1]

Trying to access blocks 06 to FF results in an error E-08 (invalid format). The loader seems to be write-protected on some machines and trying to write that block produces an E-04 (Error writing Flash).

[*1] seen in the TF6060CI firmware. It contains a tfd compressed MPEG PS stream with a single frame.

ORDER OF THE COMM EVENTS

Open the interface (some DeviceIOControls have to be sent to correctly initiate USB transfers)
Send a Reset (CMD0B)
Wait about 300ms to make sure that the Toppy has shut down its interfaces
Close and reopen the interface
Receive and ignore the loader data
Receive and ignore the loader info strings (CMDFF)
Receive the STB ID (CMD01) and transmit a download request (CMD03) to initiate a STB => PC sequence…
…or receive a CMD01 and transmit an upload request (CMD02) to initiate an PC => STB sequence
(Note: the above CMD02/CMD03 is time critical. If the response isn't sent within some ms, the Toppy will continue to boot into user mode!)
(Note: on USB transfers, the Toppy will send the CMD01 after it has received the CMD02/CMD03. Therefore the CMD02/CMD03 command has to be sent after receiving the CMDFF string)
(Note: there seems to be a bug in the USB implementation: the command byte of the CMD02 has to be 0x01 instead of 0x02 to be accepted by the Toppy!)

On STB => PC transfers:
Send a CMD07 and receive the CMD08 response to get the size of the block
Repeatedly send CMD04s and receive the requested data via CMD05s
To receive another block move back to the CMD07, otherwise stop with a CMD06 (END) and an optional CMD0B (REBOOT).

On PC => STB transfers:
Repeatedly receive a CMD04 and answer with a CMD05 until you receive a CMD06 (END)
Send an optional CMD0B (REBOOT)

Close the interface

EXAMPLE OF A SERIAL STB => PC TRANSFER WITH VEGA

Colors: <Seq> <Cmd> <Len> <CRC>

Vega (V) sends a reset to the Toppy (T) who responds with the boot message and the first "real" packet.

```
V: ToFi 00 0B 00 0B
T: 0D - 0D \ 0D | 0D 0A 0D 0A 'LOAD : NEC uPD613x Embedded Controller...' 0D 0A
T: ToFi 34 FF 18 0D 0A '<<< Loader L4.06 >>>' 0D 0A B2
```

Afterwards the Toppy sends the model and system ID, Vega answers with a download request (time critical!)

```
T: ToFi 35 01 22 01 96 1F 1D 1D FF 01 01 96 06 00 00 00 8F 22 1E D0 90 0F 04 00 88
   10 13 FF 0B B8 0D AC 05 DC 00 17 02 47
V: ToFi 35 03 00 38
```

Vega now wants to receive the user settings, the Toppy answeres with its length (0x020000)

```
V: ToFi 36 07 01 02 40
T: ToFi 36 08 03 02 00 00 43
```

Vega demands the first 255 bytes starting at 0x000000

```
V: ToFi 37 04 04 FF 00 00 00 3E
T: ToFi 37 05 FF 1F 1D 1D FF 01 … 00 00 5F
```

and so on.....

Vega demands the last block (2 bytes starting at 0x01FFFE)

```
V: ToFi 39 04 04 02 01 FF FE 41
T: ToFi 39 05 02 00 00 40
```

Now Vega requests the EEPROM; Toppy: its size is 0x000100 bytes

```
V: ToFi 3A 07 01 03 45
T: ToFi 3A 08 03 00 01 00 46
```

Vega: send them

```
V: ToFi 3B 04 04 FF 00 00 00 42
T: ToFi 3B 05 FF C3 CE 00 1A 00 1F … 44 FF FF AA
V: ToFi 3C 04 04 01 00 00 FF 44
T: ToFi 3C 05 01 00 42
```

Vega: End of the communication and do a reboot

```
V: ToFi 3D 06 00 43
V: ToFi 3E 0B 00 49
```

CRC16 ALGORITHM

The calculation is done via a 256 word lookup table.

```
0000  C0C1  C181  0140  C301  03C0  0280  C241
C601  06C0  0780  C741  0500  C5C1  C481  0440
CC01  0CC0  0D80  CD41  0F00  CFC1  CE81  0E40
0A00  CAC1  CB81  0B40  C901  09C0  0880  C841
D801  18C0  1980  D941  1B00  DBC1  DA81  1A40
1E00  DEC1  DF81  1F40  DD01  1DC0  1C80  DC41
1400  D4C1  D581  1540  D701  17C0  1680  D641
D201  12C0  1380  D341  1100  D1C1  D081  1040
F001  30C0  3180  F141  3300  F3C1  F281  3240
3600  F6C1  F781  3740  F501  35C0  3480  F441
3C00  FCC1  FD81  3D40  FF01  3FC0  3E80  FE41
FA01  3AC0  3B80  FB41  3900  F9C1  F881  3840
2800  E8C1  E981  2940  EB01  2BC0  2A80  EA41
EE01  2EC0  2F80  EF41  2D00  EDC1  EC81  2C40
E401  24C0  2580  E541  2700  E7C1  E681  2640
2200  E2C1  E381  2340  E101  21C0  2080  E041
A001  60C0  6180  A141  6300  A3C1  A281  6240
6600  A6C1  A781  6740  A501  65C0  6480  A441
6C00  ACC1  AD81  6D40  AF01  6FC0  6E80  AE41
AA01  6AC0  6B80  AB41  6900  A9C1  A881  6840
7800  B8C1  B981  7940  BB01  7BC0  7A80  BA41
BE01  7EC0  7F80  BF41  7D00  BDC1  BC81  7C40
B401  74C0  7580  B541  7700  B7C1  B681  7640
7200  B2C1  B381  7340  B101  71C0  7080  B041
5000  90C1  9181  5140  9301  53C0  5280  9241
9601  56C0  5780  9741  5500  95C1  9481  5440
9C01  5CC0  5D80  9D41  5F00  9FC1  9E81  5E40
5A00  9AC1  9B81  5B40  9901  59C0  5880  9841
8801  48C0  4980  8941  4B00  8BC1  8A81  4A40
4E00  8EC1  8F81  4F40  8D01  4DC0  4C80  8C41
4400  84C1  8581  4540  8701  47C0  4680  8641
8201  42C0  4380  8341  4100  81C1  8081  4040
```

And here is the main loop in Basic:

```
CRC = 0
For Addr = StartAddr To EndAddr
  CRC = CRCLookupTable(Data(Addr) Xor (CRC And 255)) Xor (CRC \ 256)
Next
```

ERROR CODES

E-01 Data error in downloaded data via UART (corrunpted data)
E-02 Corrupted firmware in Flash memory
E-03 Communication error with UART
E-04 Error in writing Flash memory
E-05 Too big downloaded data for the Flash memory
E-06 Error in system ID. Not compatible firmware with the receiver.
E-07 Error in system ID. Not compatible firmware with the receiver.
E-08 Error in downloaded data format
E-09 Error in reading EEPROM
E-10 Error in writing EEPROM
E-11 Unsupported Flash memory
E-13 Timeout error in OTA
E-14 Data error in downloaded data via OTA (corrupted data)
E-15 Communication error via USB

MODELID

The ModelID is a 32 bytes data block, which contains information about the hard- and software of the settopbox.

```
typedef struct
{
  word          Magic;        //=0x1F1D
  byte          DataLen;      //=0x1D
  byte          Checksum;
  byte          Version;      //=0x01
  word          SystemID;
  word          ProjectID;
  byte          AreaID;
  byte          OEMID;
  CASSpecType   CASSpec;
  HWSpecType    HWSpec;
  SWSPecType    SWSpec;
} ModelIDType;  //32 Bytes

typedef struct
{
  byte       NrCIs:2;
  byte       Conax:1;
  byte       Irdeto:1;
  byte       Res:4;
} CASSpecType;  //1 Byte
```

```
typedef struct
{
  byte       Tuner1:4;
  byte       Tuner2:4;

  word       V12:1;
  word       RF:3;
  word       tvScart:2;
  word       vcrSCart:1;
  word       RCA:2;
  word       SVideo:1;
  word       SPDIF:2;
  word       pstnModem:3;
  word       CableModem:1;

  byte       RS232C:1;
  byte       USB:3;
  byte       IEE1394:1;
  byte       Ethernet:2;
  byte       WirelessHi:1;

  dword      WirelessLo:1;
  dword      nSmartCard:2;
  dword      nFrontKeys:4;
  dword      Segment7:3;
  dword      BoxSize:2;
  dword      DRAMSize:8;
  dword      FlashSize:6;
  dword      EEPROMSize:4;
  dword      Positioner:1;
  dword      Skew:1;
} HWSpecType;  //8 bytes

typedef struct
{
  byte       RTOS:4;
  byte       MiddleWare:4;

  byte       OSD:5;
  byte       BPP:3;

  byte       MaxSat;
  word       MaxTP;
  word       MaxTV;
  word       MaxRadio;
  word       MaxSvcName;
  byte       DataSize;
} SWSpecType; //12 Bytes
```

TF5000/5500:

```
<ModelID>   = 1F 1D 1D FF 01 01 96 06 00 00 00 8F 22 1E D0 90
              0F 04 00 88 10 13 FF 0B B8 0D AC 05 DC 00 17 02

SetEdit     = 1F 00 00 00 1D 00 00 00 1D 00 00 00 84 DF 45 00
              84 00 00 00 01 00 00 00 40 48 C8 01 84 DF 45 00
```

MODEL / SYSTEMID TABLE

Device	SystemID	App Type
Procaster VF PVR5101C	10416	
Procaster VF PVR5101T	10426	
TF100C	40053	TF-CCMTC
TF100T	30053	TF-CCMTF
TF3000CI	101	
TF3000CI	121	
TF3000CI	161	
TF3000CIC	1201	
TF3000CIP	102	
TF3000CIPpro	202	
TF3000CIpro	201	
TF3000CIpro	211	
TF3000COCI	10201	
TF3000COT	10203	
TF3000COT-d	10213	
TF3000COT-N	10223	
TF3000FA	100	
TF3000FE	103	
TF3000FEI	203	
TF3000FEI	223	
TF3000FI	200	
TF3000FI, TF3000FI-N (NTSC)	240	
TF3000PVR	208	
TF3000T(유럽향) (EUR)	243	
TF3000T(호주향)(AUS)	233	
TF3030F	290	
TF3030FE	293	
TF3100C	1205	
TF3100CO-C	10215	
TF3100COT	10225	
TF3100FE	105	
TF3100FE	145	
TF3100FEI	205	
TF3100FEI	245	
TF3100FEI	295	
TF3100FEP	104	
TF3100FEP	134	
TF3100FEPpro	204	
TF3100T	1215	
TF3200IR	3200	
TF3500FE	10200	
TF4000C	508	
TF4000CO	10500	
TF4000COC	10508	
TF4000COC(러시아향)	10538	
TF4000COC(우크라이나향)	10528	
TF4000COC(핀란드향)	10518	
TF4000CO-N	10510	
TF4000COT	10503	
TF4000COT	10523	
TF4000COT	10533	
TF4000COT-N	10513	
TF4000Fe (GER)	1505	TF-DSFE
TF4000FE, TF5000FE	505	TF-MSFE
TF4000Fi	1500	
TF4000Fi	2500	

TF4000Fi	5500	
TF4000Fi (ME)	500	TF-MSFI4
TF4000Fi (Telran)	560	
TF4000Fi (UAE)	530	
TF4000Fi Plus(중동향)	50610	
TF4000Fi-N	540	
TF4000Fi-NA	550	
TF4000Fi-NB	520	
TF4000IR Plus	14000	TF-GNIrP
TF4000NA	30503	
TF4000PVR	206	TF-JPC
TF4000PVR COCI	10206	
TF4000PVR Plus	3406	TF-NPC4P
TF4000PVR Plus	3506	
TF4000PVR Plus(영국향)	3446	
TF4000PVR-N	296	
TF4000T	523	
TF4000T(일반향) (EUR)	533	TF-SFT
TF4000T(호주향) (AUS)	543	TF-SFTA
TF400PVRc	3457	
TF400PVRt	3467	TF-NPC4PT
TF4010PVR Plus	3436	TF-NPCAP
TF4010T	563	TF-SFTA
TF4100Fi	3500	TF-MSFI
TF4100Fi	4500	TF-ESFI
TF4100PVRc	3456	TF-NPC4PC
TF4100PVRt	3466	TF-NPC4PT
TF4100PVRt	3496	
TF4400PVRt (AUS)	1496	TF-NPTA4
TF4410PVRt (AUS)	1497	TF-NPTA4
TF4500T (호주향)	30202	
TF5000CI	2501	
TF5000CI (EUR)	1501	TF-ESCI
TF5000CI (GER)	3501	TF-SCI
TF5000CI (ME)	501	TF-MSCI
TF5000CI Plus	4411	TF-ESCI16
TF5000CI Plus	4501	TF-MSCI16
TF5000CI Plus	4611	TF-ESCI16
TF5000CI Plus (EUR)	4511	TF-ESCI16
TF5000CI Plus(베네룩스향)	4521	
TF5000CIP	502	
TF5000Fe	2505	
TF5000Fe (EUR), TF4000Fe	1505	TF-ESFE
TF5000Fi	507	
TF5000PVR	2466	
TF5000PVR Black Panther / White Polar	446	TF-NPCS
TF5000PVR Cd	407	TF-NCPC
TF5000PVR Masterpiece	1416	TF-NNPC
TF5000PVR Masterpiece	1516	
TF5000PVR Masterpiece (JPN)	1417	TF-NNPCJ
TF5000PVR, TF5500PVR	406	TF-NPC, TF-NCPC
TF5000PVR, TF5500PVR	506	TF-NPC, TF-NCPC
TF5000PVRc	2406	
TF5000PVR-N	426	
TF5000PVRt (EUR & AUS)	416	TF-NPT, TF-NPTA
TF5000PVRt Black Panther / White Polar (AUS)	466	TF-NPTSA
TF5000PVRt Masterpiece (AUS)	1426	TF-NNPTA
TF5000PVRt-N	1406	
TF5000T	503	
TF5000T(베트남향)	513	

TF500PVRc	12417	TF-NCPCf
TF500PVRt	13417	TF-NCPTf
TF5010PVR Black Panther / White Polar	486	TF-NPCS
TF5010PVR Masterpiece	1456	TF-NNPC
TF5010PVR, TF5510PVR	436	TF-NPC, TF-NCPC
TF5010PVRtH	13446	TF-NCPT
TF5020PVR HDMI	437	TF-NPC
TF5030PVR HDMI	447	
TF5050CI	5501	TF-ES50CID
TF5050CI HDMI	34010	
TF5050CI HDMI	34110	
TF5050CI(동유럽향)	5511	
TF5050CI(러시아향)	5521	TF-ES50CID
TF5050DVR-c	32406	
TF5050PDR	30406	
TF5100PVRc (FIN & RUS)	12406	TF-NCPCf, TF-NCPCr
TF5100PVRc HDMI	12416	TF-NCPCf
TF5100PVRc HDMI-N(북미향)(가칭)	12516	
TF5100PVRc HDMI-S(남미향)(가칭)	12316	
TF5100PVRc Masterpiece (FIN)	1486	TF-NNCPCf
TF5100PVRc Masterpiece (RUS)	2486	TF-NCPCr
TF5100PVRcE	12426	TF-NCPCf
TF5100PVRt (FIN)	13406	TF-NCPTf
TF5100PVRt HDMI (CZ)	13516	
TF5100PVRt HDMI (FIN)	13416	TF-NCPTf
TF5100PVRt Masterpiece (FIN)	1466	TF-NNCPTf
TF5110PVRc(불가리아향)	12506	TF-NCPCb
TF5200PVRc	10446	TF-NCPCd
TF5200PVRc(동유럽향)	10456	TF-NCPCe
TF5200PVRt-N	11406	
TF5300CI	541	
TF5300d	10406	
TF5300FTA	527	
TF5300k	10436	TF-NPTk
TF5400PVR combo (S&T)	1446	TF-NCNPstD
TF5410PVR HDMI (C&T)	2496	TF-NCNPct
TF550PVR	32430	TF-NCPCTfct
TF5600PVR	1436	
TF5700PVRt (SWE)	2426	TF-NPTs
TF5700PVRt HDMI	13426	TF-NPTs
TF5700PVRt Masterpiece	2436	
TF5710PVRt HDMI	13436	TF-NPTs
TF5720PVRt HDMI	13536	TF-NPTs
TF5800PVR	456	TF-NPT
TF5800PVR Masterpiece	1476	
TF5800PVRt	458	TF-NPT
TF5810PVRt	457	TF-NPT
TF5900PVR	2476	
TF5950PVR(칠레향)	2477	
TF6000COC(러시아향)	40252	TF-CCMRC
TF6000COC(핀란드향)	40052	TF-CCMFC
TF6000COCI	50070	
TF6000COK	30652	
TF6000COT	30052	TF-CCMFT
TF6000COT-k	30252	
TF6000CR	50602	
TF6000F	20000	
TF6000F	20400	
TF6000F	50010	
TF6000F	50200	

TF6000F (ME)	50000	TF-MCMFI
TF6000F New OSD(가칭)	50600	
TF6000F(동유럽향)	50700	
TF6000Fe	20002	
TF6000Fe (GER)	50202	TF-ECMFG
TF6000Fe(독일향)	50002	TF-MCMFE
TF6000Fe(독일향)	50052	TF-ECMFE
TF6000Fe, TF6200CO	50502	TF-ECMFG
TF6000FT	20200	
TF6000FT	20300	
TF6000FT	20600	
TF6000IR, TF6200IR	16200	
TF6000IRC	26000	
TF6000PVR	2416	TF-NNPCW
TF6000PVR	2516	
TF6000PVR ES	2457	TF-NNPCW
TF6000PVR WS	2417	TF-NNPCW
TF6000PVRE	2456	TF-NNPCW
TF6000PVRE	2458	
TF6000PVRE	2556	
TF6000PVRt (AUS)	2446	TF-NNPCTA
TF6000SF	50051	
TF6000SFP	50451	
TF6000T (EUR)	30002	TF-CNFET
TF6000T(싱가폴향)	30102	
TF6000T(핀란드향)	30402	
TF6000TS	30552	TF-CMFETS
TF6000TS HDMI	30062	TF-CFCZT
TF6000VI	50702	
TF600PVRc	32416	TF-NNPCCF
TF600PVRt	2447	TF-NNPCTf
TF6010FT	20500	
TF6010FT	20700	
TF6010PVR	3416	TF-NNPCW
TF6010PVR WF	3456	
TF6010PVRE	3426	TF-NPCWB
TF6060CI	10066	
TF6060CI	21031	TF-MRCI
TF6060CI(러시아향) (RUS)	21231	
TF6100COC	40452	TF-CC7MEC
TF6100COC	40962	
TF6100COC(러시아향)	40652	TF-CC7MRC
TF6100COC(루마니아향)	40952	TF-C7RC
TF6100COC(슬로베이아향)	40852	
TF6100COC(우크라이나향)	40552	
TF6100COT	30452	
TF6100CR	50612	TF-ECNCRG
TF6100DCC	40753	TF-C7BDE
TF6100EMC	40752	
TF6100F	50400	
TF6100F(중동향)	50900	
TF6100GRC(ELOB향)	40553	TF-C7GRC
TF6100GRC(슬로베니아향)	40453	
TF6100IR	16100	
TF6100SF	50050	
TF6100SF(이집트향)	50150	
TF6200CO	50504	
TF6200COC(가칭)	40152	
TF6200COT	30152	
TF6200F	50100	

TF6200F	50500	
TF6200GR	50212	TF-GMFMK
TF6200GR(BBM)	50312	TF-EGMFMB
TF6200GR(ELOB)	50412	TF-GMFME
TF6200Gr(동유럽향)	50512	
TF6300IR	16300	TF-CFIr
TF6300IRc	26300	TF-CIRC
TF6310IR(태국향)	16310	
TF6400IR	16400	TF-GNIr
TF6400IRc	26500	
TF6400SF	50251	
TF6410IR(인도향)	16410	
TF6500F	20001	
TF6500F	20201	
TF6500F	50101	
TF6500F	50201	
TF6500F (ME), TF6400FTA	50001	TF-MCNFE
TF6500F New OSD(가칭)	50601	
TF6500F Plus(중동향)	50003	TF-MCNFE
TF6500IRc	26400	
TF6500T_HDMI	30063	
TF6700CO(브라질향)	50603	
TF6700CO(칠레향)	50503	
TF6700COC(브라질향)	40454	
TF6700IRt(아르헨티나향)	16700	
TF6700SF	50053	
TF6800F	50103	
TF6800F	50203	
TF6900Fe	50402	
TF7000HDPVRt	32040	
TF7000HT	31019	
TF700HSCI	23042	
TF7010HT	31020	TF-HFTA-VE
TF7050HDRt	33032	
TF7700HCCF (Cabletel)	43031	TF-HCCF
TF7700HCCF (DCC)	43032	TF-HCCF
TF7700HCCF (MSAT)	43030	TF-HCCF
TF7700HCCI (EU)	43022	
TF7700HCCI (GER)	43022	
TF7700HCCI(러시아향)	43122	
TF7700HDPVR (AT)	23531	
TF7700HDPVR (EUR), TF7710HDPVR	23031	
TF7700HDPVR (GER)	23231	
TF7700HDPVR, TF7710HDPVR (CZ)	23131	
TF7700HSCI	23122	
TF7700HSCI (POL)	23322	
TF7700HSCI (RUS)	23222	
TF7700HSCI(BOE)(가칭)	23025	
TF7700HSCI(독일향) (EUR)	23022	
TF7700HTCI	33022	
TF7700HTCO(ntv향)	33150	
TF7710HCCI	43023	
TF7710HDPVR	23431	
TF7710HDPVR (NL)	23331	
TF7710HSCI	23023	
TF7710HSCI (GER)	23123	
TF7710HTCI	33023	
TF7710HTCO	33050	
TF7720HSCI	23224	
TF7720HSCI	23324	

TF7720HSCI	23424	
TF7720HSCI (동유럽향)	23124	
TF7720HSCI(유럽향)	23024	
TF7720HSIR	23026	
TF8000	27000	
TF800PVR HDMI	439	
TMS (SR-2100)	22010	
Wildcard	39321	

FRONTPANEL COMMUNICATION

The communication runs with the following scheme: **<STX> Command [Parameters] <ETX>**. The lower nibble of 'Command' is the number of parameters to follow. <STX> is the character 0x02, <ETX> is 0x03.

Yellow: FP => Mainboard

Cmd		Reply	Function	Sample	Comments
			Time		
10	O	13	ReqFPTime	`10`	Request time from front panel clock
11	O	--	FPTimeFormat	`11 81` `11 80`	Time format in standby (81=24h, 80=12h)
13	I		FPTime	`13 0f 28 12`	Answer to command 0x10. This sample shows the response for 15:40:18
30	O	25	ReqFPDateTimeNew	`30`	The command 0x25 is the response to this request.
25	I		FPDateTimeNew	`25 0c 96 ae 28 01`	This is the response to Cmd 30 and seems to have the same purpose as Cmd 15 except it uses the new data format (see also commands 74 & 84). See below for the date format.
30	I	15		`30`	The FP wants to know the time
15	O		FPDateTime	`15 d2 57 0e 28 01`	This command sends the current time to the front panel. The format is "15 DD DD HH MM SS" where DD is a MJD number. The following sample sets the front panel to 22.04.2006 14:40:01 local time.
			Display		
35	O		SetLED	`35 af 86 c6 a3 ff`	This command sends the pattern for the front panel LED display. The bits are inverted therefore a 1 means that the segment is switched off. The sample to the left shows the string "rECo".
91	O	--	FPDisplayBufferFill	`91 xx`	MP VFD: Fills the internal 48 bytes buffer with xx. Only useful xx: 00 (display off) and ff (all segments)

99	O		MPVFDData	`99 00 c0 0e 0c 78 31 61 c2 08`
				`99 08 02 00 00 00 00 00 00`
				`99 10 3c 00 00 00 00 00 00`
				`99 18 00 00 00 04 20 f0 00 00`
				`99 20 03 c1 40 fd 40 00 d0 eb`
				`99 28 00 00 00 00 00 00 00`
					The 0x99 command writes into the 48 byte Masterpiece Display Buffer. The second byte contains the start address of the buffer and the next 8 bytes are written into the buffer (see the MP VFD PDF for details).

A2	O		MPBrightness	`A2 08 xx`	Sets the brightness of the MPs VFD. 0x20 is the maximum. 01, 02, 08, 10, 20
Cx	O		5500VFDData		5500 VFD

			Timer		
72	O	--	FPWakeupClear	`72 ff ff`	This command seems to delete all wakeup timers in the front panel
74	O	--	SetFPWakeup	`74 d2 58 06 00`	This command seems to inform the front panel about the wakeup time. The format is "74 DD DD HH MM" where DD is a MJD number. The sample sets the wakeup timer to 23.04.2006 06:00 local time. The Toppy seems to send the next 3 entries to the FP (see also commands 15 & 25).
84	O	--	SetFPWakeupNew	`84 0c 97 c6 00`	The command 84 seems to have the same purpose as command 74 but uses a different format. See below for the date format.
			Keys		
51	I		FPKey	`51 06`	This command is used to send front panel keystrokes to the main board (e.g. the Vol Up button).
51	O				
61	I		RemoteKey	`61 1c`	This command is used to send remote keystrokes to the main board (e.g. the OK button). Add 0x0080 for repeated key codes.
A0	O	A5	GetRemoteFilter	`A0`	Lets the FP generate 4 A5 messages with the current IR filter values.
A5	I	--	ReportRemoteFilter		See below for the meaning of the bytes

A5	O	--	SetRemoteFilter	`A5 13 20 DF 0A 1B`
				
				`Mode 1 = 02 34 0A`
				`Mode 2 = 49 00 0A`
				`Mode 3 = 49 99 0A`
				`Mode 4 = 20 DF 0A`
					Sets one of four filter for the remote control. The second byte contains the filter number (x0 to x3) and if the filter should be enabled (0x or 1x), the bytes 3 to 5 contain the remote code and byte 6 is a checksum (chk = ([1] + [2] + [3] + [4] - 1) & 0xff).

			Power		
20	I		ShutdownReq	`20`	This command is repeatedly sent by the front panel in case somebody hit the power button.
31	O			`31 00`	Locks the FP buttons (incl. remote), VFD and shutdown event
31	O	--	PowerOff	`31 01`	Turns the Toppy off
31	O		ShutdownAck	`31 02`	Used by the firmware to acknowledge the ShutdownReq 0x20. If this isn't sent within a specific time, the FP processor assumes that the main processor is stuck and shuts the Toppy down. This command unlocks the FP buttons (opposed to 31 00) but disables the standby event. In this state, pressing standby will generate a 61 0a (remote) or 51 00 (FP).
31	O			`31 03`	???
31	O			`31 04`	Unlocks buttons, VFD and shutdown event
31	O			`31 05`	Unlocks buttons and shutdown event
31	O			`31 06`	Reboots the Toppy by toggling the power line for about 1 second.
21	O		Shutdown	`21 01`	This sequence turns off the Toppy.
40	O	--	GetDisplayControl	`40`	Stops the FP shutdown watchdog and returns the display control to the firmware.
41	O	--		`41 44` `41 88`	Last Power Status (44=on, 88=off). This variable is responsible for the VF&F.
80	O	81	ReqBootReason	`80`	Ask the front panel why it has bootet up the Toppy.

81	I		BootReason	81 01	The response to the 0x80 command. Known responses: 00=front panel button, 01=remote power button or power failure, 02=timer
			Other		
B2	O	B3	FPPeek	B2 F0 FF B2 F1 FF B2 F2 FF B2 F3 FF B2 F5 FF	Peeks a byte from the FP CPU memory. F0 to F3 is used as a FP-ID (MP=A6 00 00 00; TF5500=A5 56 46 44)
B3	I		FPPeekAnswer	B3 Fx FF xx	
B3	O	--	FPPoke	B3 F5 FF 01	Pokes a byte into the FP CPU

			Unknown		
54	O	--		54 FF FF 00 00	
E0	O	E4			
E4	I			E4 0B 05 00 00	

The new date word is calculated as following:

```
{
        word    Date;
        byte    DayOfWeek:3;
        byte    Hour:5;
        byte    Minute;
        byte    Seconds;
}
```

Date = (((year - 2000) & 0x7f) << 9) | ((month & 0xf) << 5) | (day & 0x1f)

e.g. `0c 97` = 2006-04-23

HARDWARE
MEMORY ADDRESS MAP

Taken from a TF5000.

80000000-83FFFFFF: Cached RAM (64MB)
84000000-87FFFFFF: RAM Shadow of 80000000 (64MB)
88000000-8BFFFFFF: RAM Shadow of 80000000 (64MB)
8C000000-8FFFFFFF: RAM Shadow of 80000000 (64MB)

9F000000-9FBFFFFF: unknown nearly constant pattern (12MB)

9FC00000-9FDFFFFF: Flash Shadow
9FE00000-9FFFFFFF: Flash Shadow

A0000000-A3FFFFFF: Uncached RAM Shadow of 80000000 (64MB)
A4000000-A7FFFFFF: RAM Shadow of 80000000 (64MB)
A8000000-ABFFFFFF: RAM Shadow of 80000000 (64MB)
AC000000-AFFFFFFF: RAM Shadow of 80000000 (64MB)

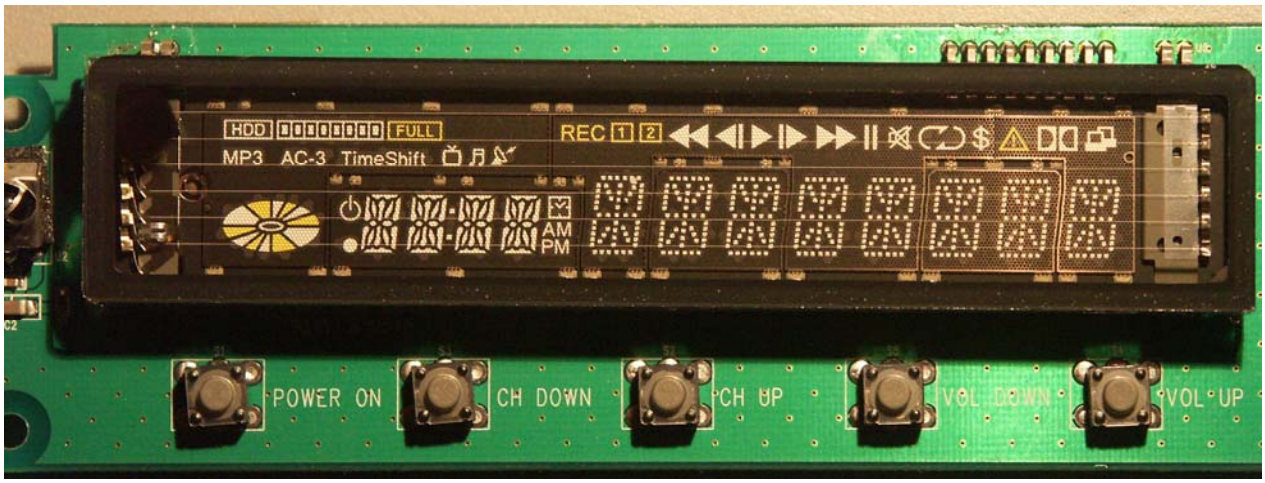
B0000000-BFBFFFFF: EMMA Hardware Register

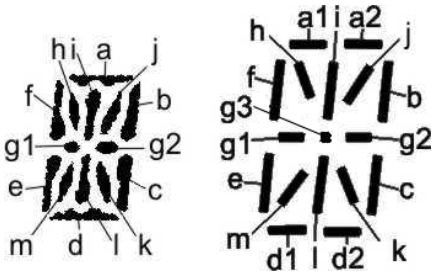
BFC00000-BFC01FFF: Flash - Primary Loader (8kB)
BFC02000-BFC0FFFF: Flash - Secondary Loader (56kB, compressed)
BFC10000-BFDBFFFF: Flash - Firmware (1,7MB compressed)
BFDC0000-BFDDFFFF: Flash - Sat/Timer... Tables (128kB compressed)
BFDE0000-BFDFFFFF: Flash - Factory Settings (128kB compressed)

BFE00000-BFFFFFFF: Flash Shadow

TF5000 MASTERPIECE VFD

The display is a Samsung HCV-03SM06T.





The digits are counted from left.

	7	6	5	4	3	2	1	0
00								
01			Power	Remote Dot (?)	14 Seg / Digit 1 / d	14 Seg / Digit 1 / e	14 Seg / Digit 1 / c	14 Seg / Digit 1 / l
02	14 Seg / Digit 1 / m	14 Seg / Digit 1 / k	14 Seg / Digit 1 / g1	14 Seg / Digit 1 / g2	14 Seg / Digit 1 / b	14 Seg / Digit 1 / f	14 Seg / Digit 1 / j	14 Seg / Digit 1 / h
03	14 Seg / Digit 1 / i	14 Seg / Digit 1 / a	14 Seg / Digit 2 / d	14 Seg / Digit 2 / e	14 Seg / Digit 2 / c	14 Seg / Digit 2 / l	14 Seg / Digit 2 / m	14 Seg / Digit 2 / k
04	14 Seg / Digit 2 / g1	14 Seg / Digit 2 / g2	14 Seg / Digit 2 / b	14 Seg / Digit 2 / f	14 Seg / Digit 2 / j	14 Seg / Digit 2 / h	14 Seg / Digit 2 / i	14 Seg / Digit 2 / a
05	Clock Colon	14 Seg / Digit 3 / d	14 Seg / Digit 3 / e	14 Seg / Digit 3 / c	14 Seg / Digit 3 / l	14 Seg / Digit 3 / m	14 Seg / Digit 3 / k	14 Seg / Digit 3 / g1
06	14 Seg / Digit 3 / g2	14 Seg / Digit 3 / b	14 Seg / Digit 3 / f	14 Seg / Digit 3 / j	14 Seg / Digit 3 / h	14 Seg / Digit 3 / i	14 Seg / Digit 3 / a	PM
07	AM	Timer Symbol	14 Seg / Digit 4 / d	14 Seg / Digit 4 / e	14 Seg / Digit 4 / c	14 Seg / Digit 4 / l	14 Seg / Digit 4 / m	14 Seg / Digit 4 / k
08	14 Seg / Digit 4 / g1	14 Seg / Digit 4 / g2	14 Seg / Digit 4 / b	14 Seg / Digit 4 / f	14 Seg / Digit 4 / j	14 Seg / Digit 4 / h	14 Seg / Digit 4 / i	14 Seg / Digit 4 / a
17			17 Seg / Digit 2 / d1	17 Seg / Digit 3 / d1	17 Seg / Digit 2 / d2	17 Seg / Digit 3 / d2	17 Seg / Digit 2 / e	17 Seg / Digit 3 / e
18	17 Seg / Digit 2 / c	17 Seg / Digit 3 / c	17 Seg / Digit 2 / l	17 Seg / Digit 3 / l	17 Seg / Digit 2 / m	17 Seg / Digit 3 / m	17 Seg / Digit 2 / k	17 Seg / Digit 3 / k
19	17 Seg / Digit 2 / g1	17 Seg / Digit 3 / g1	17 Seg / Digit 2 / g2	17 Seg / Digit 3 / g2	17 Seg / Digit 2 / g3	17 Seg / Digit 3 / g3	17 Seg / Digit 2 / b	17 Seg / Digit 3 / b
20	17 Seg / Digit 2 / f	17 Seg / Digit 3 / f	17 Seg / Digit 2 / j	17 Seg / Digit 3 / j	17 Seg / Digit 2 / h	17 Seg / Digit 3 / h	17 Seg / Digit 2 / i	17 Seg / Digit 3 / i
21	17 Seg / Digit 2 / a1	17 Seg / Digit 3 / a1	17 Seg / Digit 2 / a2	17 Seg / Digit 3 / a2	17 Seg / Digit 6 / d1	17 Seg / Digit 7 / d1	17 Seg / Digit 6 / d2	17 Seg / Digit 7 / d2
22	17 Seg / Digit 6 / e	17 Seg / Digit 7 / e	17 Seg / Digit 6 / c	17 Seg / Digit 7 / c	17 Seg / Digit 6 / l	17 Seg / Digit 7 / l	17 Seg / Digit 6 / m	17 Seg / Digit 7 / m
23	17 Seg / Digit 6 / k	17 Seg / Digit 7 / k	17 Seg / Digit 6 / g1	17 Seg / Digit 7 / g1	17 Seg / Digit 6 / g2	17 Seg / Digit 7 / g2	17 Seg / Digit 6 / g3	17 Seg / Digit 7 / g3
24	17 Seg / Digit 6 / b	17 Seg / Digit 7 / b	17 Seg / Digit 6 / f	17 Seg / Digit 7 / f	17 Seg / Digit 6 / j	17 Seg / Digit 7 / j	17 Seg / Digit 6 / h	17 Seg / Digit 7 / h
25	17 Seg / Digit 6 / i	17 Seg / Digit 7 / i	17 Seg / Digit 6 / a1	17 Seg / Digit 7 / a1	17 Seg / Digit 6 / a2	17 Seg / Digit 7 / a2	CD Symbol - Center Circle	CD Symbol - 12h
26	CD Symbol - 1h	CD Symbol - 2h	CD Symbol - 3h	CD Symbol - 4h	CD Symbol - 5h	CD Symbol - 6h	CD Symbol - 7h	CD Symbol - 8h
27	CD Symbol - 9h	CD Symbol - 10h	CD Symbol - 11h	Sat Dish	Music Symbol	TV Symbol	TimeShift	AC-3
28	MP3	HDD FULL	HDD Fullness Frame	HDD Fullness 8	HDD Fullness 7	HDD Fullness 6	HDD Fullness 5	HDD Fullness 4
29	HDD Fullness 3	HDD Fullness 2	HDD Fullness 1	HDD Symbol				
33			17 Seg / Digit 1 / d1	17 Seg / Digit 8 / d1	17 Seg / Digit 1 / d2	17 Seg / Digit 8 / d2	17 Seg / Digit 1 / e	17 Seg / Digit 8 / e
34	17 Seg / Digit 1 / c	17 Seg / Digit 8 / c	17 Seg / Digit 1 / l	17 Seg / Digit 8 / l	17 Seg / Digit 1 / m	17 Seg / Digit 8 / m	17 Seg / Digit 1 / k	17 Seg / Digit 8 / k
35	17 Seg / Digit 1 / g1	17 Seg / Digit 8 / g1	17 Seg / Digit 1 / g2	17 Seg / Digit 8 / g2	17 Seg / Digit 1 / g3	17 Seg / Digit 8 / g3	17 Seg / Digit 1 / b	17 Seg / Digit 8 / b
36	17 Seg / Digit 1 / f	17 Seg / Digit 8 / f	17 Seg / Digit 1 / j	17 Seg / Digit 8 / j	17 Seg / Digit 1 / h	17 Seg / Digit 8 / h	17 Seg / Digit 1 / i	17 Seg / Digit 8 / i
37	17 Seg / Digit 1 / a1	17 Seg / Digit 8 / a1	17 Seg / Digit 1 / a2	17 Seg / Digit 8 / a2	17 Seg / Digit 4 / d1	17 Seg / Digit 5 / d1	17 Seg / Digit 4 / d2	17 Seg / Digit 5 / d2
38	17 Seg / Digit 4 / e	17 Seg / Digit 5 / e	17 Seg / Digit 4 / c	17 Seg / Digit 5 / c	17 Seg / Digit 4 / l	17 Seg / Digit 5 / l	17 Seg / Digit 4 / m	17 Seg / Digit 5 / m
39	17 Seg / Digit 4 / k	17 Seg / Digit 5 / k	17 Seg / Digit 4 / g1	17 Seg / Digit 5 / g1	17 Seg / Digit 4 / g2	17 Seg / Digit 5 / g2	17 Seg / Digit 4 / g3	17 Seg / Digit 5 / g3
40	17 Seg / Digit 4 / b	17 Seg / Digit 5 / b	17 Seg / Digit 4 / f	17 Seg / Digit 5 / f	17 Seg / Digit 4 / j	17 Seg / Digit 5 / j	17 Seg / Digit 4 / h	17 Seg / Digit 5 / h
41	17 Seg / Digit 4 / i	17 Seg / Digit 5 / i	17 Seg / Digit 4 / a1	17 Seg / Digit 5 / a1	17 Seg / Digit 4 / a2	17 Seg / Digit 5 / a2	REC	Tuner 1
42	Tuner 2	<<	<|	>	|>	>>	||	Mute
43	AutoRewind Left Circle	Auto Rewind Right Circle	$	Attention	Dolby			Computer Symbol

TOPFIELD TF-5XXX HARD DISK STRUCTURE

The following samples are based on a TF5000 80GB HDD. It has been formatted with 2068 sectors per cluster. The first cluster is called the System Cluster, but Topfield doesn't count it as a cluster. Therefore the first cluster (cluster 0) starts at sector 2068. The data uses the big endian (Motorola) format. In addition every 4 bytes block is mirrored. For example, the string „ABCDEFGHIJKL" is saved as „DCBAHGFELKJI".
Following the cluster structure:

Cluster#	Data
-	System Cluster
0	Root Directory
1	Recycle Directory
2	DataFiles Directory
3	ProgramFiles Directory
4	MP3 Directory
5…n	Data

The cluster size is based on the least common multiple of a disk sector (512) and a TS packet (188) = 24064. It is calculated the following way:

- Get the numbers of tracks, heads and sectors of the disk (depends on the OS)
- Calculate the disk size in GB (DiskSize = Tracks * Heads * Sectors / 1048576 / 2)
- Calculate the LCM factor from the disk size (LCMFactor = Ceil (Ceil (DiskSize / 47 * 16) / 4) * 4)
- The minimum LCM factor is 44 (If LCMFactor < 44 Then LCMFactor = 44)
- Now calculate the cluster size (SectorsPerCluster = 24064 * LCMFactor / 512)

The last cluster number is calculated with the following formula: LastCluster = (DiskSize / SectorsPerClusters / 512) - 1.

SYSTEM CLUSTER

The system cluster contains the super block, the root directory and the FAT. The size of the root directory is 254 sectors and the FAT can allocate up to 768 sectors. With 2068 sectors per cluster, a 130GB disk can be managed ((1023-256+1 FAT-Sectors) * 512 BytesPerSector / 3 BytesPerCluster * 2068 SectorsPerCluster * 512 BytesPerSector).

Sector#	Sectors	Data
0	1	Super Block
1	1	Copy of the Super Block
2-255	254	Root Directory
256-698	443	FAT24-1
699-1023	325	FAT24-1 (not used by the Toppy: 80GB-border)
1024-1466	443	FAT24-2
1467-1791	325	FAT24-2 (not used by the Toppy: 80GB-border)
1792-2067	276	unused

The above sector numbers are always the same, regardless of the disk size. The root directory in sector 2 is an incomplete copy of the root directory in cluster 0.

SUPER BLOCK (SECTOR 0)

```
          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
00000000h: 07 08 26 07 54 4F 50 46 49 45 4C 44 20 54 46 35 30 30 30 50 56 52 20 48 44 44 00 00 00 00 00 00 ; ..&.TOPFIELD TF5000PVR HDD......
00000020h: 01 01 08 14 00 00 00 00 00 00 E8 7E 00 10 25 80 00 A3 DA CF 00 00 00 00 00 00 00 00 00 00 00 00 ; ..........è~..%€.£ÚÏ............
00000040h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000060h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000080h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000000a0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000000c0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000000e0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000100h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000120h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000140h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000160h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000180h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000001a0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000001c0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000001e0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
```

0x0000 Magic number	0x07082607
0x0004 HD ID 5000:	TOPFIELD TF5000PVR HDD
0x0004 HD ID 4000:	TOPFIELD PVR HDD
0x0020 Layout Version:	V1.1
0x0022 Sectors per Cluster:	2068
0x0024 Root Start Cluster	
0x0028 Nr. of used Clusters	
0x002C Empty Bytes in Root	
0x0030 FAT_CRC32	

The FAT_CRC32 is based on the same polynomial as WinZIP. The only difference is that Topfield doesn't use a reflection and the last XOR is not done. The checksum is calculated over the FAT, rounded to the next sector boundary. The following formula used:

FatSize:=512 * Ceil (3 * LastCluster / 512);

Bit size	= 32
Polynomial	= 0x04C11DB7
Start	= 0xFFFFFFFF
Data Reflection	= no
Output Reflection	= no
XOR Out	= 0x00000000

FAT (SECTOR 256)

Topfield uses a FAT24 system (3 bytes per cluster). The following sample shows the first 96 bytes. Like DOS and Windows, there are 2 FATs, which are kept synchronous. The maximum size of one FAT is 768 sectors, which means that it can address up to 131072 clusters.

```
00020000h: FF FF FE FF FF FE FF FF FE FF FF FE FF FF FE 00 00 06 00 00 07 00 00 08 00 00 09 00 00 0A 00 00 ; ÿÿþÿÿþÿÿþÿÿþÿÿþ.................
00020020h: 0B 00 00 0C 00 00 0D 00 00 0F FF FF FE 00 00 10 00 00 11 00 00 12 00 00 13 00 00 14 00 00 16 FF ; ..........ÿÿþ..................ÿ
00020040h: FF FE 00 00 17 00 00 18 00 00 19 00 00 1A 00 00 1B 00 00 1C 00 00 1D 00 00 1E 00 00 1F 00 00 20 ; ÿþ............................
```

xxxxxx	Points to the next cluster
FFFFFF	free cluster
FFFFFE	last used cluster

The 2nd FAT is starting at 0x80000. All entries after the last cluster (rounded to the next sector boundary) may contain useless data, because this area is ignored by the format command. The size of the FAT is calculated by the following command: NumberOfClusters = Int (HDTracks * HDHeads * HDSectors / SectorsPerCluster). For example a 120GB hard drive: 14596 Tracks * 255 Heads * 63 Sectors / 2068 SectorsPerCluster = 113387 Clusters. This number of clusters needs 332kB or 665 sectors. Therefore the FAT is valid for the area from 0x20000 to 0x731FF and from 0x80000 to 0xD31FF.

ROOT DIRECTORY (CLUSTER 0, SECTOR 2068 IN THE ABOVE SAMPLE)

```
          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
00000000h: F1 FF FF FF FF FF FF FF 00 00 00 00 00 00 00 01 00 10 25 80 5F 5F 52 4F 4F 54 5F 5F 00 5F 5F 00 ; ñÿÿÿÿÿÿÿ.........%€__ROOT__.__.
00000020h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
00000040h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
00000060h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 31 FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ1ÿÿÿ

00000080h: F3 FF FF FF FF FF FF FF 00 00 00 01 00 00 00 01 00 10 27 00 5F 5F 52 45 43 59 43 4C 45 5F 5F 00 ; óÿÿÿÿÿÿÿ.........'.__RECYCLE__.
000000a0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000000c0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000000e0h: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF BA FF FF FF ; ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿºÿÿÿ

00000100h: F2 00 00 00 00 00 00 00 00 00 00 02 00 00 E7 6E 00 10 27 00 44 61 74 61 46 69 6C 65 73 00 00 00 ; ò.............ç...'.DataFiles...
00000120h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000140h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000160h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0F 00 00 00 ; ..............................‰...

00000180h: F2 00 00 00 00 00 00 00 00 00 00 03 00 00 00 18 00 10 27 00 50 72 6F 67 72 61 6D 46 69 6C 65 73 ; ò.................'.ProgramFiles
000001a0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000001c0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000001e0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 32 00 00 00 ; ..............................2...
```

Every directory entry is 128 bytes long.
It uses the same fields as “normal” files except for some fields, which are not used (e.g. the file date). It is not clear why the system entries (“__*”) are padded with 0xFF.
The above __ROOT__ entry points to cluster 0, which is the real Root directory. The above entries are static and are not updated if the contents of the disk changes.

See Directory DataFiles for field details.

DIRECTORY DATAFILES (CLUSTER 2)

Following are some sample recordings. The directories also use the famous „.“ and „..“ directories.

```
          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
00000000h: F1 00 00 00 00 00 00 00 00 00 00 02 00 00 00 01 00 10 1C 80 2E 00 00 00 00 00 00 00 00 00 00 ; ñ.................€.........
00000020h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000040h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
00000060h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 EE 00 00 00 ; ............................î...

00000080h: F0 FF FF FF FF FF FF FF 00 00 00 00 00 00 00 01 00 10 26 80 2E 2E 00 4F 4F 54 5F 5F 00 5F 5F 00 ; ð.................&€..OOT__.__.
000000a0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000000c0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................................
000000e0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 7B 00 00 00 ; ............................{...

00000100h: D1 CF 99 15 34 00 00 00 00 00 00 05 00 00 12 CA 00 0B C0 00 46 61 63 65 2F 4F 66 66 20 2D 20 49 ; ÑÏ™.4.........Ê..À.Face/Off - I
00000120h: 6D 20 4B F6 72 70 65 72 20 64 65 73 20 46 65 69 6E 64 65 73 2D 31 2E 72 65 63 00 00 00 00 00 00 ; m Körper des Feindes-1.rec......
00000140h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 50 72 6F 53 69 65 62 65 6E 00 00 00 ; ProSieben.....................
00000160h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 04 03 00 00 50 00 00 00 ; ............................P...
```

e.g.: Face/Off, 20.05.2004 21:52, Start Cluster 5, Size: 4810 Clusters = 4.74GB ((0x12CA*2068-0x0BC0/2-1)*512+512), partly scrambled (yellow/green key)

File Attrib:
- D0 … File (created by Altair)
- D1 … File (created by the Toppy)
- F0 … ‘..’ Directory
- F1 … ‘.’ Directory
- F2 … Subdirectory
- F3 … Recycle-directory
- FF … unused

Flags:
- 0000 … not scrambled
- 0400 … descrambled (by a copy) (green key)
- 0401 … scrambled (yellow key)
- 0402 … descrambled (green key)
- 0403 … partly scrambled (yellow/green key)
- 0200 … File is locked

File Date/Time: DD DD HH MM SS OO OO (DDDD=MJD=days since 17.11.1858)
OOOO = local offset (0000 if set manually)

Start-Cluster

File Size:
- 0x0C … Number of Clusters (let’s call the field S1)
- 0x10 … Number of unused sectors in the last cluster in bytes (S2)
- 0x7E … Number of bytes in the last sector (mod 0x200) (S3)

S3_CRC: 0x7D … = ((S3 >> 8) + (S3 & 0xff) + 1) & 0xff

Size = S1*SectorsPerCluster * 512 - S2 - 512 + S3
(add 512 instead of S3 if S3_CRC == false)

File name: terminated by a 0x00

Service name: terminated by a 0x00

WinFileAttribute: Contains the Windows FILE_ATTRIBUTE flags if a file has been copied from the PC (little endian, not used by the firmware).

Unknown fields:
- 0x73 … __temprec__.* has a 0x04, all other a 0x00
- 0x74 … .taps and .mp3 have a 0x20, all other a 0x00
- 0x7C … seems to be a checksum (starting from Layout v1.1)

The S1 field of the „.“-directory contains the size of the current directory and therefore is always 1. The field S2 holds the number of free bytes in that current directory and can be calculated by: S2 = 512*SectorsPerCluster-(128*UsedSlots). A slot is a single directory entry. In other words: NextSlot = (512*SectorsPerCluster-S2)/128

The S1 field of the „..“-directoy contains the same value as the S2-field of the parent directory while it as created.

The S1-field of a subdirectory contains the sum of all used clusters plus the size of the subdirectory itself; S2=0; S3=0

TOPFIELD REC HEADER

TF5000

```
          00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
00000000h: 54 46 72 63 50 00 00 00 00 01 00 01 00 00 01 00 12 34 32 CA 03 EA 01 F4 01 F4 81 F5 4F 52 46 32 ; TFrcP.....ORF2
00000020h: 00 69 73 63 68 65 73 20 46 53 00 00 00 00 00 00 00 00 00 00 01 80 00 00 00 00 31 94 55 F0 04 5D ; .isches FS.....
00000040h: 80 00 00 01 80 00 01 1F 00 00 16 82 D2 9A 12 0F D2 9A 13 2E 04 08 00 05 48 65 6C 70 20 54 56 05 ; .....Help TV.
00000060h: 48 65 6C 70 20 54 56 00 20 4B 75 6C 74 75 72 40 6E 65 72 00 00 00 00 05 41 6C 70 65 6E 77 65 74 ; Help TV. Kultur@ner.....Alpenwet
00000080h: 74 65 72 00 6C 00 00 00 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00 00 05 41 52 54 45 20 4B 75 6C ; ter.l.....ARTE Kul
000000a0h: 74 75 72 00 00 00 00 00 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00 01 05 44 61 73 20 47 65 73 74 ; tur.....Das Gest
000000c0h: FC 74 05 31 34 2E 20 45 69 6E 20 70 61 61 72 20 5A 65 6E 74 69 6D 65 74 65 72 00 00 00 00 00 00 ; ..... Ein paar Zentimeter.....
000000e0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 40 00 00 00 00 00 00 01 05 49 63 68 2C 20 48 75 62 ; .....Ich, Hub
00000100h: 65 72 74 75 73 05 4B 75 72 7A 66 69 6C 6D 20 44 65 75 74 73 63 68 6C 61 6E 64 20 32 30 30 36 00 ; ertus.Kurzfilm Deutschland 2006.
00000120h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 40 00 00 00 00 00 00 01 05 5A 61 70 70 69 6E 67 20 ; .....Zapping
00000140h: 49 6E 74 65 72 6E 61 74 69 6F 6E 61 6C 05 44 61 73 20 69 73 72 61 65 6C 32 CA 00 00 00 00 00 00 ; International.Das israel.....
00000160h: 00 00 00 00 02 00 00 00 32 CA 01 6D 00 00 16 82 05 2D 20 53 65 78 65 6E 74 7A 75 67 20 66 FC 72 ; .....- Sexentzug für
00000180h: 20 52 61 73 65 72 20 52 6F 6C 61 6E 64 20 41 73 73 69 6E 67 65 72 2C 20 42 72 75 64 65 72 20 64 ;  Raser Roland Assinger, Bruder d
000001a0h: 65 73 20 4D 69 6C 6C 69 6F 6E 65 6E 73 68 6F 77 2D 4D 6F 64 65 72 61 74 6F 72 73 2C 20 73 74 65 ; es Millionenshow-Moderators, ste
000001c0h: 6C 6C 74 20 73 65 69 6E 20 56 65 72 6B 65 68 72 73 70 72 6F 6A 65 6B 74 20 76 6F 72 20 2D 20 44 ; llt sein Verkehrsprojekt vor - D
000001e0h: 65 72 20 4B 61 6D 70 66 20 67 65 67 65 6E 20 64 61 73 20 4B 75 63 6B 75 63 6B 73 6B 69 6E 64 20 ; er Kampf gegen das Kuckuckskind
…
00000520h: 6D 61 73 20 57 FC 70 70 65 72 20 28 52 69 63 68 61 72 64 20 47 72 69 65 73 65 29 2C 20 55 64 6F ; mas Wüpper (Richard Griese), Udo
00000540h: 20 53 63 68 65 6E 6B 20 28 45 77 61 6C 64 20 48 6F 72 74 65 6E 29 20 75 2E 61 2E 20 52 65 67 69 ;  Schenk (Ewald Horten) u.a. Regi
00000560h: 65 3A 20 4D 69 63 68 61 65 6C 20 4D 61 63 6B 00 00 00 00 00 02 00 00 00 00 00 00 00 52 00 00 00 B6 ; e: Michael Mack.....
00000580h: 00 00 01 32 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; .....
…
```

TF5800

```
          00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
00000000h: 54 46 72 63 50 10 00 00 00 00 00 01 00 00 00 00 06 30 10 84 10 84 02 62 02 62 82 64 42 42 43 20 ; TFrcP.....0.„.„.b.b,dBBC
00000020h: 54 57 4F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 19 08 00 00 07 B8 90 ; TWO.....¸
00000040h: 10 04 00 00 23 3A 30 05 80 00 02 0A 00 00 A1 AE D2 9A 10 32 D2 9A 13 00 04 0E 00 57 69 6D 62 6C ; ....#:0.€.....¡®Òš.2Òš.....Wimbl
00000060h: 65 64 6F 6E 20 32 30 30 36 53 70 6F 72 74 00 72 72 65 6E 74 20 61 66 00 00 00 00 54 6F 64 61 79 ; edon 2006Sport.rrent af....Today
00000080h: 20 61 74 20 57 69 6D 62 6C 65 64 6F 6E 53 70 6F 72 74 00 65 6E 20 22 00 00 00 00 54 68 65 20 43 ;  at WimbledonSport.en "....The C
000000a0h: 6F 6E 76 65 6E 74 44 6F 63 75 6D 65 6E 74 61 72 79 00 74 60 42 75 69 00 00 00 00 52 6F 6F 6D 20 ; onventDocumentary.t`Bui....Room
000000c0h: 31 30 31 45 6E 74 65 72 74 61 69 6E 6D 65 6E 74 00 6E 20 62 54 68 65 00 00 00 01 4E 65 77 73 6E ; 101Entertainment.n bThe....Newsn
000000e0h: 69 67 68 74 4E 65 77 73 20 61 6E 64 20 43 75 72 72 65 6E 74 20 41 66 66 61 69 72 73 00 4D 5A 4F ; ightNews and Current Affairs.MZO
00000100h: 4F 4B 69 43 68 69 6C 64 72 65 6E 00 69 6C 64 72 65 6E 20 62 54 68 65 00 00 00 02 57 68 65 6E 20 ; OKiChildren.ildren bThe....When
00000120h: 54 6F 62 79 20 4D 65 74 20 4A 75 6C 69 65 3A 20 54 68 65 20 53 74 6F 72 79 20 6F 66 20 74 68 65 ; Toby Met Julie: The Story of the
00000140h: 20 4D 6F 64 65 72 6E 20 52 65 76 69 65 77 44 6F 63 75 6D 65 6E 74 61 72 79 20 22 42 10 84 00 00 ;  Modern ReviewDocumentary "B.„..
00000160h: 00 00 05 63 05 77 00 00 02 00 00 00 10 84 01 1E 00 00 A1 AE 54 68 65 20 61 63 74 69 6F 6E 20 63 ; ...c.w.....„....¡®The action c
00000180h: 6F 6E 74 69 6E 75 65 73 20 66 72 6F 6D 20 74 68 65 20 41 6C 6C 20 45 6E 67 6C 61 6E 64 20 43 6C ; ontinues from the All England Cl
000001a0h: 75 62 2C 20 77 69 74 68 20 74 68 65 20 62 65 73 74 20 6F 66 20 74 6F 64 61 79 27 73 20 6D 61 74 ; ub, with the best of today's mat
…
00000540h: 74 61 63 6B 6C 65 20 74 68 65 20 70 61 69 6E 20 6F 66 20 68 65 72 20 63 68 69 6C 64 68 6F 6F 64 ; tackle the pain of her childhood
00000560h: 2E 20 5B 53 5D 20 5B 57 5D 00 68 65 60 62 65 73 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 26 ; . [S] [W].he`bes.....&
00000580h: 00 00 00 4A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ...J.....
…
00000660h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; .....
00000680h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; .....
…
00000e60h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; .....
00000e80h: 01 DD 0A 9B C0 A9 35 1C 09 4E 20 CD 7C 0D 81 D6 83 49 9C 0A 21 3F 81 55 E0 09 06 74 FE 2D 5C A0 ; .Ý.›À©5..N Í|. ÖƒIœ.!? Uà..tþ-\
```

```
typedef struct
{
  dword  MagicNumber;   //0x54467263 (TFrc)
  word   Version;       //0x5000, 0x5010
  byte   reserved1 [2];
  word   Duration;      //in minutes
  word   ServiceNr;
  word   ServiceType;   //0=TV, 1=Radio
} tRECHeader;           //14 bytes
```

```
typedef struct
{
  byte   SatIndex;      //DVB-s only
  byte   reserved1;
  word   TPIdx:10;
  word   TunerNum:2;
  word   DelFlag:1;
  word   CASFlag:1;
  word   LockFlag:1;
  word   SkipFlag:1;
  word   ServiceID;
  word   PMTPID;
  word   PCRPID;
  word   VideoPID;
  word   AudioPID;      //Note 1
  char   ServiceName [24];
} tRECServiceInfo5000; //38 bytes
```

```
typedef struct
{
  byte   SatIndex;      //DVB-s only
  byte   reserved1;
  word   TPIdx:10;
  word   TunerNum:2;
  word   DelFlag:1;
  word   CASFlag:1;
  word   LockFlag:1;
  word   SkipFlag:1;
  word   ServiceID;
  word   PMTPID;
  word   PCRPID;
  word   VideoPID;
  word   AudioPID;      //Note 1
  char   ServiceName [28];
} tRECServiceInfo5010; //42 bytes
```

```
typedef struct
{
  byte   SatIndex;

  byte   Polarization:1;
  byte   Mode:3;        //0=Normal, 1=SmaTV
  byte   reserved1:4;

  byte   reserved2 [2];
  dword  Frequency;     //in MHz
  word   SymbolRate;
  word   TSID;
  byte   reserved3 [2];
  word   NetworkID;
} tRECTPInfoSat;        //16 bytes
```

```
typedef struct
{
  word   ChannelNumber; //Note 2
  byte   Bandwidth;     //in MHz
  byte   reserved1;
  dword  Frequency;     //in kHz
  word   TSID;
  byte   LPHPStream;    //0=LP, 1=HP
  byte   reserved2;
  word   NetworkID;
  byte   unknown1 [2];
} tRECTPInfoTer;        //16 bytes
                        //Note 3
```

```
typedef struct
{
  dword  Frequency;
  word   SymbolRate;
  word   TSID;
  word   NetworkID;
  byte   Modulation;    //0=16QAM, 1=32QAM,…
  byte   unused1;
} tRECTPInfoCable;      //12 bytes
```

Note 1: 0x8xxx = Auto, 0x2xxx = AC3 channel, 0x0xxx = fixed language
Note 2: In Australian F/W versions, the ChannelNumber is coded in BCD while a decimal number is used in European versions.
Note 3: The transponder block on a TF5700PVRt (HDMI) is 8 bytes longer than on other machines. The meaning of the extra data is not yet known.

```
typedef struct
{
  byte    reserved1 [2];
  byte    DurationHour;
  byte    DurationMin;
  dword   EventID;
  word    StartTimeMJD;
  byte    StartTimeHour;
  byte    StartTimeMin;
  word    EndTimeMJD;
  byte    EndTimeHour;
  byte    EndTimeMin;
  byte    reserved2;
  byte    TextLength;
  byte    ParentalRate;
  char    EventName [TextLength];//no 0x00 terminator!
  char    EventDescription [257 - TextLength];        //Note 4
  char    unknown1 [18];
} tRECEventInfo;                  //294 bytes
```

```
typedef struct
{
  word    TextLength;
  dword   EventID;
  char    Text [1024];
} tRECExtendedEventInfo;
          //1030 bytes
```

```
typedef struct
{
  byte    reserved1 [4];
  byte    CryptFlag;          //Note 5
  byte    reserved2 [3];
} tRECCryptInfo;          //8 bytes
```

```
typedef struct
{
  dword   Bookmark [64];          //Note 6
} tRECBookmarks;          //256 bytes
```

```
dword    Resume;
byte     reserved [2048];
```

Note 4: The EventDescription buffer might contain other information
Note 5: Crypt Flag: 00=FTA, 01=scrambled, 02=descrambled, 03=partly scrambled
Note 6: Bookmarks are saved in 512 x (Size of a TS Packet) units (=94kB). This makes them independent of the cluster size.

A note from R2-D2:
The .rec header is different on the TF5810. There are only 48 bookmarks, and so the later sections are moved down by 64 bytes. This is the same on the TF500/TF600, which share a lot of things in common with our firmwares and the TF5810 in particular. The "reserved[2048]" section is actually a collection of up to 512 block indexes (like bookmarks) that specific the places where a recording was paused ("cut points") -- the firmware uses these to cover up the glitch at the cut point, but it's very badly programmed. Now, the Resume bookmark seems to be a feature that's only in our TF5800 and TF5810 firmwares (plus almost all TF500 and TF600 firmwares) -- if you've got it then there is an option to press Play (rather than OK) on a recording in the archive to "resume" it from the last played position. On all other firmwares this is the count of the "cut points". But it is actually that on our firmwares, too... So the clever covering up of the glitch points would only be seen on our firmwares the first time the file is played. DOH! I can't see any way to judge whether there are 64 or 48 bookmarks in any given .rec header without knowing the model that made it. :(

HOW TO AUTO DETECT THE REC HEADER TYPE

Use the following rules for the type decision: count 1 point for every matching rule

for dvb-s:
  RECTPInfoSat.Polarization & 0x6F == 0 ?
  RECTPInfoSat.SymbolRate in [2000...30000] ?
  RECTPInfoSat.Frequency in [10700...12800] ?

for dvb-t
  RECTPInfoTer.Bandwidth in [6..8] ?
  RECTPInfoTer.Frequency in [174000...230000] || [470000...862000] ?
  RECTPInfoTer.LPHPStream & 0xFE == 0 ?

for dvb-c
  RECTPInfoCable.Frequency in [47000...862000] ?
  RECTPInfoCable.SymbolRate in [2000...30000] ?
  RECTPInfoCable.Modulation <= 4 ?

If one system gets 3 points and all other less than 3, you've found the headers system type.